The AMSAT® Journal

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Numerous Arrow antennas laid siege to AO-27 from the Battlefield Inn parking lot in Vicksburg, Mississippi during the 16th AMSAT Annual Meeting and Space Symposium. The Battlefield Inn is located adjacent to the Vicksburg National Military Park that commemorates the site of the Civil War siege of Vicksburg that took place in 1863. (photo by Phillip Fortenberry, N5PF)

Southern Hospitality Greets AMSAT!

Over 160 persons attended the 16th AMSAT Annual Meeting and Space Symposium in Vicksburg, Mississippi from October 16-18, 1998. Participants from six countries attended the meeting at the Battlefield Inn located next to the Vicksburg National Military Park where the historic siege of Vicksburg took place in 1863. Numerous technical presentations were given during the symposium including:

- *Antarctica and Amateur Radio*, Ron Ross, KE6JAB
- *The History of the Amateur Satellite Program*, Martin Davidoff, K2UBC
- *Intermediate Circular Orbits for Amateur Radio Satellites*, Ken Ernandes, N2WWD
- *J-Station – An Update*, John Melton, N6LYT/G0ORX
- *An Omni-Directional Antenna for Receiving Mode J LEO Satellites*, Tony Monteiro, AA2TX

[continued on page 4]

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The **Kansas City Tuner** Option provides automatic doppler-shift compensation for digital satellite work. The **Tuner** is compatible with most rigs including Yaesu, Kenwood, and ICOM. It controls your radio thru the radio's serial computer port (if present) or through the radio's up/down mic-click interface. The **Kansas City Tuner** Option is perfect for low-orbit digital satellites like the NOAA and Microstat satellites.

The **Kansas City Tracker** and **Tuner** include custom serial interfaces and do not use your computer's valuable COMM ports. The software runs in your PC's "spare time," letting you run other programs at the same time.

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The AMSAT Journal staff is always interested in article submissions. Whenever possible, text should be on IBM compatiable diskettes with hardcopy or original photographs or figures. AMSAT-NA reserves the right to select material for *The AMSAT Journal* based on suitability of content and space considerations. The editors of this publications are volunteers giving freely of their talents, time, and efforts to produce *The AMSAT Journal*.

Apogee View

On Teams and Teamwork
By Keith Baker, KB1SF

My, what a busy two weeks it has been! In my first two weeks as your new AMSAT President, we've seen the conclusion of a very enjoyable and productive AMSAT Space Symposium and Annual meeting at Vicksburg, Mississippi, a very successful Ariane 503 launch, the completion of Phase 3D's Thermal Vacuum test, and the launch of not one but TWO new Amateur Radio Satellites, SEDSAT-1 and PANSAT into orbit! As this edition of the Journal goes to press, the new birds were still undergoing checkout in their newfound space environments. It is truly a fantastic time to be a contributing member of AMSAT, and I am truly honored to be asked to be your President for the upcoming term.

Your previous President, Bill Tynan, W3XO has left the organization in good shape overall, and he is to be strongly commended for the fine job he has done in that position over the years. Thanks, Bill! However, Bill will be the first to admit, as he hands over the reigns of command, that there are still a few areas requiring some urgent attention. One of these is the severe drain the Phase 3D project is now having on our financial reserves as we finish it up and prepare it for eventual launch. The other is the shrinking numbers and variety of volunteers within our ranks. I'll address the former issue in detail in a subsequent Apogee View. However, I believe the latter issue is something that needs to be reversed quickly if the organization is to continue fulfilling its mission in the months and years ahead.

That's because, as I now take on these new responsibilities as your incoming President and I begin contemplating how I should lead your organization in the future days and months, I keep coming back to a single, stark reality...I, alone, can't accomplish a *thing* without many, many others also doing their part for the organization.

It is teamwork that's the essential ingredient in the work that we do in AMSAT. It's the glue that binds us together and allows us to successfully do what we do. Take a few moments now to glance to the left of this column at the list of Directors and Officers of the Corporation. You'll see a number of very hard working people listed there. However, what you *won't* see are the people who are also ably assisting each of those Vice Presidents and other Corporate officers. It is *all* of these people, working together as a team, who keep the organization on a steady track. As we used to say in the Air Force, it's where the "rubber meets the ramp."

These are the people who are now working late hours, nights and weekends down at the Phase 3D Lab in Orlando to ensure we have a spaceworthy satellite to fly at some time in the (hopefully) near future, or the long list of Area Coordinators who freely give of their time and talents to insure AMSAT is well represented at major Hamfests around the country. It's the team of people at our AMSAT Office who assist Martha with the day-to-day tasks of interacting with a 5000+ member organization. It is the team of people who help Russ Tillman, K5NRK make sure that you have the latest edition of the AMSAT Journal in your hands in a timely way. It's the team who help our new Executive Vice President, Robin Haighton, VE3FRH coordinate AMSAT's mentoring of students at the University of Toronto and their MOST satellite project. I could go on and on, as there are scores of other teams working just as hard within our organization, but I think you see my point.

Now, while the team leader (the VP) gets to see their names on the masthead, each will readily tell you that they, too, couldn't do their jobs without the rest of their respective teams giving them a hand to help out.

Unfortunately, many of those teams are getting awfully thin right now, and some are down to one person...the VP themselves. You could say that a number of others are a mile wide and an inch deep. Therefore, one of my major goals as your new President will be to not only put the organization on a sounder (eventually a *self-sustaining*) financial footing, but also to *grow* the organization from within by greatly expanding the membership on our teams in each functional area.

That is why I'm urging each of you now to seriously consider volunteering your time and talents to us by serving on a team in one or more of the areas listed in our masthead.

If you have a skill...ANY skill.....and some spare time that you think could even be marginally useful to us, please do not hesitate to contact the appropriate VP (usually via their callsign and @amsat.org e-mail address, or via their Callbook postal address) and indicate your willingness to help out.

There's been a mistaken impression over the years that, unless you had a Ph.D. in applied physics or engineering, AMSAT neither wanted or needed your help. Nothing could be further from the truth! While our experimenters are doing a lot of the *hands on* design and operation of our satellites, there are a number of other areas that also need some non-technical help. For example, right now we are desperately need someone with graphic art/layout and design skills to give us a hand in designing a new advertising campaign to bring new members into the organization, as well as a volunteer coordinator with human resources experience to help us better manage our people resources.

Now, I know we've aired these "please help us" pleas in the past, and some of you may have responded that you were interested, but one or more of us on the AMSAT side didn't appear to respond quickly enough to your offer.

Therein lies part of the problem. It takes person-power from within the organization to create and sustain person-power. As I said, right now we are so thin in a lot of functional areas that the various VPs are barely keeping their heads above water. What we (and they) really need are *self-starters*...people who don't need a lot of hand-holding to get up to speed quickly. These are people who are willing to try new things or take on a task and produce results without a lot of guidance and direction. If you are one of those people and have a skill that might be useful to us, we'd like to hear from *you*!

Once again, I'm honored to have been selected to serve as your new President. My only hope is that I'll prove to be worthy of the sacred trust that also goes with it. ■

[Southern Hospitality continued from page 1]

- *TRAKNET: An AMSAT Mobile Satellite System*, Bob Bruninga, WD4APR
- *SETI on the Cheap: Affording the Ultimate DX*, Paul Shuch, N6TX
- *Working Satellites from Over 100 Grid Squares*, Chuck Duey, KI0AG
- *The Year 2000 Transition – Your PC and AMSAT Software*, Roy Welch, W0SL

Looking to the future, the following presentations were made on proposed space missions that are in various stages of development:

- *Advancing Radio Communications Technology with the Citizen Explorer Mission*, Ellen Riddle, et.al.
- *An EZ Sat Update*, Fred Winter, N2XOU and Ken Ernandes, N2WWD

A Houston AMSAT Net Interview with Clifford Uyeda, KJ6HC

The Houston AMSAT Net was represented at the Saturday evening AMSAT banquet by Bruce Paige, KK5DO who conducted several interviews that were later replayed on the Tuesday evening net (see *http://www.amsatnet.com*).

KK5DO: Alright, we are here at the AMSAT Sympsoium banquet talking with Clifford, KJ6HD of Kenwood. I see that you brought the new Kenwood TH D7A HT with you. As I understand it, this HT is being introduced this month and listeners can see a picture of it on the back page of this month's QST issue (November 1998). Can you tell us about the radio and where you see its use within the ham community?

Clifford Uyeda, KJ6HC: Thank you Bruce. This new TH D7A is going to open a lot of doors in regards to usage of Amateur Radio. It has the versatility of being a very portable 2-meter/440 dual-band hand-held. It has a lot of controls such as being able to control your HF radio remotely. It has APRS capabilities so that you can plug GPS units into the side as well as if you want to do APRS activities. It also has a built in TNC packet node controller so that you can also do a lot of packet activities as well as being a complement to our new visual communicator (VC-H1) you have remote control of its features. Just imagine buying one handheld and being able to do a lot of the packet activities that you would not be able to do with a normal radio; you would have to buy accessory equipment like terminal node controllers. Now for all of you HF enthusiasts, there is a DX packet cluster feature already built into the radio. The software is built in so you can actually see the streaming packet updates for the reporting system right on the radio's screen. So you don't need anything else as it is completely portable. We are really excited about this radio as there are many different things that you can do with it that you can't do with a normal dual-band HT.

KK5DO: Ok, great. Now I know that everyone is familiar with 1200 bd packet and that is very common. A lot of radios in the past and the new ones you have to modify to operate 9600 bd. I understand that this radio has capability for 9600 bd.

Clifford Uyeda, KJ6HC: Yes Bruce. That is correct. This built-in TNC is a 9600 bd with ready capabilities.

KK5DO: What type of ham would really be apt to buy on of these? Is it the guy that has everything, is it a beginner, or does it just fit the bill for about everybody.

Clifford Uyeda, KJ6HC: It really fits the bill for everybody. For the new enthusiast that is just getting into the hobby you can buy one radio and do quite a bit. You don't have those extra TNC cables to hook up. You don't have various other TNC components that you have to hook up; it is really a self-contained package. Now for those who are already in the hobby, just think, you can take your station out into the field in just on handheld without the need for additional equipment.

KK5DO: Ok Cliff. Thank you very much. I think this is going to be something that I would like to get and I bet that there are a lot of other people that are going to find it very, very useful. The large-scale integration of surface-mounted chips makes these things possible. The radio does have a jack on the side to hook up your GPS unit, PC, earphone, or microphone. What about GPS in the future? Is it possible that a future version will have GPS built-into the unit?

Clifford Uyeda, KJ6HC: That is interesting Bruce because Kenwood is one of the leaders in trying to do a lot to bring the new technology to the amateur market. We will just have to wait and see as this radio has so much itself; but Kenwood will continue to design new products. We would like to have feedback. We have a webserver on our homepage where you can sign up to receive all of the updates via our listserver.

KK5DO: Ok, great. We thank you for taking the time to answer some questions.

- *International Space Station Status*, Will Marchant, KC6ROL
- *JAWSAT Update*, Randy Kohlwey, N7SFI
- *The MOST Microsatellite Mission: Canada's First Space Telescope*, Robert Zee, et.al.
- *Nanosatellite Program – A Challenge for Collaboration to Use the Amateur Bands*, Bob Twiggs, KE6QMD
- *The Phase 3D Spacecraft Thermal Design*, Dick Jansson, WD4FAB
- *Phase 3D Update*, Lou McFadin, W5DID
- *SAPPHIRE – Stanford's First Amateur Satellite*, Bob Twiggs, KE6QMD

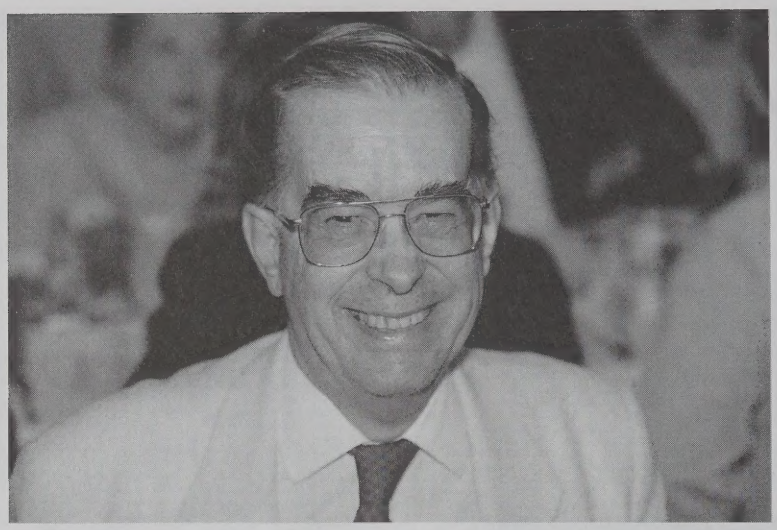
The traditional Saturday evening AMSAT Banquet was a success with good food, speakers, entertainment, and prizes. The Honorable Robert M. Walker, Mayor of Vicksburg welcomed participants to Vicksburg and was impressed with AMSAT's accomplishments and innovations. ARRL Vice President Joel Harrison, W5ZN was keynote speaker giving a very interesting retrospective presentation of Amateur Radio issues. He also reiterated ARRL's continual support to complete the Phase 3D project by successfully getting the satellite into orbit.

Like previous banquets, numerous awards were presented for AMSAT member's contributions. Bill Tynan, W3XO was presented numerous awards for his past seven years of service as AMSAT-NA president. On behalf of ARRL, Joel Harrison, W5ZN presented W3XO with a plaque of appreciation. Keith Baker, KB1SF, who was later installed as AMSAT President, presented W3XO with an AMSAT logo pin that was flown on the first Shuttle-Mir mission (STS-71) by Mission Commander Charles Precourt, KB5YSQ. John Melton, G0ORX accepted a plaque on behalf of Ron Broadbent, G3AAJ, former AMSAT-UK Secretary and Treasurer for exemplary service to the Amateur Radio satellite community. Martha Saragovitz, AMSAT-NA Secretary was honored for her twenty years of service. Also Harry (JA1ANG) and Yoshiko Yoneda were recognized for coming the farthest and received a nice coffee table book of San

Keith Baker, KB1SF (l) presenting Bill Tynan, W3XO (r) with an AMSAT lapel pin that was flown on STS-71. The commemorative certificate authenicating the pin was signed by STS-71 Mission Commander Charles Precourt, KB5YSQ. (photo by Phillip Fortenberry, N5PF)

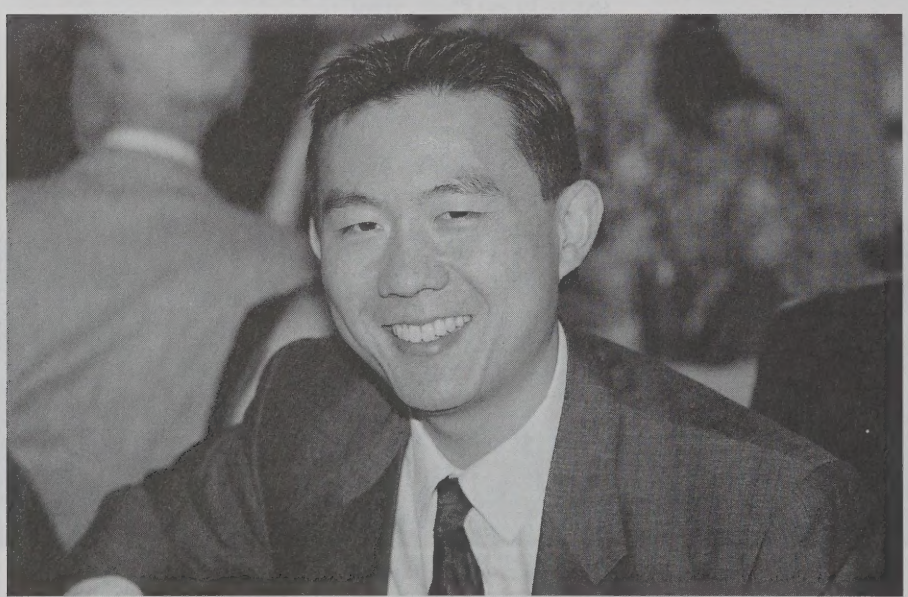
The Honorable Robert M. Walker, Mayor of Vicksburg welcomed symposium participants to Vicksburg. The AMSAT Symposium has sparked the Mayor's interest in getting licensed. (photo by Art Feller, W4ART)

Harry (JA1ANG) and Yoshiko Yoneda came the farthest to Vicksburg from Tokyo, Japan. Afterwards they continued their travels by flying to the Maryland to observe the Phase 3D thermal tests. (photo by Art Feller, W4ART)



Robin Haighton, VE3FRH host of last year's symposium in Toronto, was appointed by the AMSAT Board of Directors as Executive Vice President. (photo by Art Feller, W4ART)

No symposium would be complete without the Dave (WB6LLO) and Leanore (KA6UCD) Guimont Jewerly Contest! This year was no exception with Richard Peacock, W2GFF beating out 100 entries by correctly estimating the value of a chip capacitor ingrained into a bolo tie at 870 pF. Leanore elloquently gave a politically correct presentation of the results at the Saturday evening banquet. (photo by Art Feller, W4ART)



Kenwood Vice President Clifford Uneyda,KJ6HC attended the symposium and awarded a dual-band mobile Kenwood TM-G707A to Stewart Haag, W4MO. (photo by Art Feller, W4ART)

Diego, California, site of the 1999 AMSAT-NA symposium.

Like past banquets, over 100 prizes were given away during the banquet. Clifford Uyeda, KJ6HC, Vice President of Kenwood presented Stewart Haag, W4MO with a Kenwood TM-G707A dual-band mobile transceiver. Alan Biddle, WA4SLA won an ICOM T7A HT. Martin Jue, K5FLU, Vicksburg native and President of MFJ Enterprises presented Billy Simpkins, KF0CK with a Mirage 2-meter 160W amplifier. Meanwhile Ken Chaffee, WA1QXR won two round-trip tickets on Southwest Airlines courtesy of Bruce Paige, KK5DO. Mildred Knight won a $200 Ham Radio Outlet gift certificate courtesy of Vicksburg Chemical, producer of nitrogen tetroxide as an oxydizer for the space shuttle reaction control system and Titan rocket.

On Sunday morning, participants took a field trip to the U.S. Army Engineer Waterways Experiment Station (WES) which is the major R&D facility for the Corps of Engineers. Participants were given an overview of WES as well as a special presentation on using satellites to track sea turtles. Field trip participants also toured WES coastal physical model facilities and simulators where they were briefed on several wave tank and coastal basin projects. The field trip was completed with a tour of the WES centrifuge that is capable of delivering 400 Gs on two-ton payloads associated with a variety of research topics.

A very important part of the Symposium was the AMSAT-NA Board of Directors meeting. After seven years of devoted service, Bill Tynan, W3XO, indicated he was stepping down as AMSAT-NA President. The BOD commended W3XO for his outstanding accomplishments and many long years as President. In recognition of his unique qualifications and knowledge of the organization, it was unanimously agreed that Bill should become Chairman of the Board of Directors. He graciously accepted the Board's appointment to this new position.

The Board elected the following AMSAT officers:

- Keith Baker, KB1SF; President
- Robin Haighton, VE3FRH; Executive Vice President
- Stan Wood, WA4NFY; Vice President, Engineering

- Keith Pugh, W5IU; Vice President—Operations
- Martha Saragovitz, Corporate Secretary
- Art Feller, W4ART; Treasurer

All other incumbent officers were re-appointed to their respective positions. In addition, the BOD appointed Russ Tillman, K5NRK, *The AMSAT Journal* editor, as Vice President for Publications, and Dan James, NN0DJ, current AMSAT News Service Editor as Vice President for Public Affairs. Both of these posts were recently created or re-created.

In other matters, the BOD reviewed the current status of the Phase 3D project and the schedule for completion and testing of the spacecraft to make it flight-ready. The BOD also approved an Educational Assistance contract with the University of Toronto, Canada, for AMSAT-NA volunteers to mentor students and staff designing and constructing the Microvariability of Stars (MOST) satellite — slated to be launched in late 2001 (see AMSAT Journal Telemetry on page 22). In return, the University will make a substantial monetary contribution to AMSAT-NA. In addition, a decision was also made by AMSAT-NA to ask individuals or groups to submit proposals to design and build an Amateur Radio package that may fly on this satellite. Newly elected Executive Vice President Robin Haighton, VE3FRH has posted design considerations on the AMSAT-BB concerning the proposed amateur package.

The Board also recognized the many substantial contributions made by the membership during the past year. A complete list of these individuals, along with the full minutes of the Board meeting, will be published in the next issue of *The AMSAT Journal*.

Now is the time to start making plans to attend the 17th AMSAT Annual Meeting and Space Symposium that will be held in San Diego, California in October 1999. Duane KO6BT and Jean KC6QHT Naugle are Symposium Chairs for this event and look forward to hosting AMSAT members in southern California. Look for details on the next AMSAT symposium that will be provided via *www.amsat.org*, AMSAT News Service Bulletins and *The AMSAT Journal*. ■

A Houston AMSAT-Net Interview with Mayor Robert Walker

KK5DO: We are here at the symposium with the Honorable Robert Walker, who's the Mayor of Vicksburg and he has spent the evening with us. What did you think of your introduction to ham radio that you have been experiencing over the past few months especially this evening.

Mayor Walker: I am really impressed. I'm leaving here convinced that I am going to become involved in the operation of ham radio. I see it as a necessity in any community because if other communication systems fail you've got an old reliable way here and not only can you communicate within communities but you can communicate throughout the whole world. I am just excited and I am so happy that I was included in tonight's program.

KK5DO: Do you think that if you become a licensed ham that it would help influence more of your constituents to become licensed?

Mayor Walker: There is no question about it. We have some people on our staff who are licensed and I talked with one a few minutes ago and they are going to help me and I am going to help spread the word.

KK5DO: Ok, we really appreciate your hospitality and all the fun we have had in Vicksburg over the past couple days and we look forward to working you on the air.

Mayor Walker: Thank you very much and we want you all to come back and spend some more time with us.

Left to Right. Bill (W0OQC) and Virginia Briles of Derby, Kansas visit with Jane and Paul (K5VAS) Stonestreet of Shreveport, Louisiana.

The Jackson Amateur Radio Club greeted AMSAT members that arrived at the Jackson International Airport. (photo by Bill McLarty, KM5GE)

— Many Thanks to the Following For Donating Prizes —

- **Kenwood Corporation**, Long Beach, CA - 144/440 MHz Dual Band Mobile Transceiver, TM-G707A
- **ICOM America**, Inc, Bellevue, WA - 144/400 MHz Handheld Transceiver, IC-T7A
- **MFJ Enterprises**, Miss. State, MS - Mirage B-2516-G 160W 2-Meter Amplifier
- **Bruce Paige, KK5DO**, Houston, TX - Round-trip Ticket for Two on Southwest Airlines
- **Vicksburg Chemical**, Vicksburg, MS - $200 Gift Certificate from Ham Radio Outlet
- **Advanced Receiver Research**, Burlington, CT - 144 MHz GaAsFET Preamp
- **American Radio Relay League**, Newington, CT - 1999 ARRL Handbook (2)
- **American Radio Relay League**, Newington, CT - *QEX* Subscription (2)
- **American Radio Relay League**, Newington, CT - *QST* Subscription
- **American Radio Relay League**, Newington, CT - Radio Amateur's Satellite Handbook (11 autographed copies)
- **American Radio Relay League**, Newington, CT - *QEX*, September/October 1998 Issue (50)
- **Antique Electronics Supply**, Tempe, AZ - Coffee Mugs
- **Arrow Antenna**, Cheyenne, WY - 146/437-10 Antenna w/ Duplexer and Cables
- **Bjorn Audio Video**, San Antonio, TX - DDS Dish – 18" (9)
- **Buckmaster**, Mineral, VA - Buckmaster - CD ROM Callbook
- **CQ Communications**, Hicksville, NY - *CQ VHF* Subscription (2)
- **CQ Communications**, Hicksville, NY - *CQ VHF*, November issue (200)
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Special Event Station K5ZRO was operated by Ed Magruder, N5QDE; Eddie Pettis, N5JGK; and Carolyn Irons, KJ5RC (right) of the Vicksburg Amateur Radio Club during the AMSAT Annual Meeting and Symposium. The station made 325 HF QSOs and 17 two-meter simplex QSOs. In addition, N5JGK made 25 satellite QSOs from his QTH. N5QDE reports many interesting QSOs including lots of Europeans on Saturday morning and a call from Kuwait (9K) who was operating in the Boy Scouts' JOTA. On Sunday the special event station worked Diego Garcia (VQ9) in the Indian Ocean and also NN3SI, the Smithsonian Institute Amateur Radio station (we've already received a card from them!). Since it was JOTA weekend, many Boy Scout stations were contacted. Also during the symposium many participants were contacted on 146.520 MHz. Those wishing QSLs may send SASE to N5QDE, 2485 Warrenton Road, Vicksburg, MS 39180. So far, N5QDE has received over 70 requests for QSL cards. (photo by Harry Yoneda, JA1ANG)

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- Ron Brown, AB5WF – Jackson Airport Welcome
- Lloyd Causey, K5IMT – Net Control Talk-in
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We Talk to Mir! - An Interview with Andy Thomas, VK5MIR

Chris Edmondson, VK3CE

Editor's Note: This article originally appeared in the Australian publication titled "Radio and Communications." Many thanks to "Radio and Communications" Editor Chris Edmondson, VK3CE for sharing this article with Journal readers.

I've said it before, and I'll say it again: Amateur Radio is a wonderful thing. Connecting via packet radio to an orbiting spacecraft, or using one to bounce a voice signal back to somebody else on Earth is wonderful – but actually talking to an astronaut (an Australian-born one at that) is another thing altogether!

Such was my very great thrill and privilege in late April and early May 1998, just as the May issue was hitting the newsstands. Forty-six year old Australian Dr. Andrew (Andy) Thomas, a US astronaut serving aboard the Russian Space Station *Mir*, was talking to all comers on the two-meter VHF band – in plain voice, via a stock standard Kenwood Amateur Radio transceiver. And the very first time I called him, he heard me and called back.

Andy is a NASA-trained astronaut who follows in the footsteps of two previous Australian astronauts, Phil Chapman and Paul Scully-Power, although only Scully-Power had flown into space (the ill-fated *Challenger*, 1984) before Thomas joined the elite club. Andy first flew as payload specialist on the 10-day STS-77 in May, 1996, before heading over to Star City, Russia, for training in the Soyuz and *Mir* programs. During that year, everything he did was in Russian.....quite a steep learning curve for a very complex language and another feather in an already accomplished man's cap.

Our first conversation, on April 21, 1998 lasted about five minutes or so, which was the very first time I heard him active using voice. I called Andy after he had been chatting for some time with Ian Hunt, VK5QX. Okay, it was just after 0115 local time, and most folk are well and truly asleep by then, but I'd been wanting a voice contact with *Mir* for a long time. I'd been listening on the channel for a long time in what I expected would be a forlorn hope. I was using the quiet time of the day when the phones generally don't ring to get some work done, and I dropped everything in a big hurry when I heard Andy as clear as a bell in contact with some VK6s, followed by his contact with Ian.

The biggest surprise of all, though, was that he was still there on his next orbit an hour and a half later, still happily chatting to all comers. He had traveled more than 43,000 km in the time it had taken me to sort out the order the stories would appear in this issue! This time I was ready with a tape recorder, so I asked him a few questions. I repeated the exercise on the next orbit, too, and followed it up several times more over the next few days to complete the interview which follows. So I should explain at the outset that what you read below was recorded over a period of several days, in bits and pieces.

Look, this chat we had didn't happen because I'm the editor of this publication. I doubt Andy had ever heard of me. He's been living in outer space for the last few months, and before that spent a year in Russia. I was just lucky, but it proves a point...any radio amateur with a two-meter FM transceiver can work the cosmonauts aboard *Mir* or the astronauts on the US Space Shuttles when they're carrying SAREX equipment. Anybody! And anybody with no more than a hand-held scanner radio would be able to hear them too, as clear as a bell. Dial up 145.985 MHz and wait. Be patient.

Each *Mir* orbit takes 92 minutes, and only about half of the orbits bring *Mir* within visual range of Australia. But do wait, because you will hear something, either packet radio noises or voice.

Privately, I reckon, Andy was a bit homesick. I certainly would be after such a long time away. But whichever, we've been the clear winners, because he's recently been very active on the radio during his free time. Very active indeed. Over the four-day period between our first contact and my writing this article, I have spoken to him on no fewer than nine occasions — really quite a highlight to my Amateur Radio career!

Last night as I was writing, at about 0200 local time, I was coming back from a quick late night dash to the shops. As usual, I'd forgotten the milk. While I was still on the road, Andy finished a contact and nobody else called him, so I had a crack at it from the car. We spoke for another two or three minutes until I arrived at home, then I jumped out of the car and ran into the middle of the road. You see, I also had a five-watt two-meter hand-held radio with a quarter-wave whip with me. Andy had clearly heard me from the 50 watt radio in the car, and could just, pretty weakly, make out the signals from the HT. Remarkable! According to the computer tracking program I use here, at the time *Mir* was just on 1500km from my location. On a hand-held radio!!!

Andy Thomas, VK5MIR Interview

I'd have to say that Dr. Andrew Thomas is an amazing gentleman and a wonderful ambassador for both Australia and Amateur Radio. What follows is a condensed selection of our conversations:

Q: Firstly, on behalf of the amateurs and radio hobbyists of Australia, thanks once again for taking time out to talk to us all. The tapes are rolling... I don't want to waste any time, so I'll get right into it. What makes up a normal day for cosmonaut Andy Thomas? What sort of work do you do?

A. Well, I'm doing research up here, conducting some science experiments, so I get up in the morning, brush my teeth like anybody else, shave, have breakfast, start the day doing these experiments — they're biological experiments, and some material science experiments. We're also doing some studies on the effects of weightlessness on the human body, so we're using ourselves as test subjects, and as the day progresses I usually take a break at one o'clock and exercise. I do 30 or so minutes on a treadmill, to help counteract the effects of weightlessness. Lunch is usually late in the afternoon, about four, then back to work. I usually work through to about seven, and then dinner and relax a little bit... watch a video, maybe read, then go to bed around 11 or 12. How copy? Over...

Q. *I've got you Q5, Andy, and the beam's coming around a bit to follow you. Okay, so tell me: what's it really feel like, taking off in a capsule on the top of a rocket or, as you did, aboard the Space Shuttle? Is it scary, and is the sensation of acceleration much like*

take-off in a commercial jet airplane, only more so? Over...

A. To start with, I didn't have time to feel scared. I was very busy and well prepared for the experience. The take-off itself starts off quite gently, at about 1.2 Gs or something, and it builds up over the course of the burn to about three Gs, so it is pretty much like what you'd get in a high-speed aircraft, except it's more sustained, it's longer lasting. It just keeps going and going for about just over eight or so minutes it takes to get you up to about 30,000 kilometers per hour. It just keeps going and burning up continuously for that period of time, and that's how you accumulate such a high velocity. So the main thing is that the push just keeps on and doesn't go away. It's sustained for the whole eight-and-a-half minutes until you get to the orbital speed. Over...

Q. *Roger. I guess that must have been a real thrill. But after all that pushing you arrived at what must surely be a view to kill for up there. I guess you'd never get bored looking out the window... or do you? What sort of things do you see from such an exclusive lofty vantage point? Can you see the lights of individual cities as you fly by, and do you use binoculars to make things sharper and clearer? Over...*

A. Oh, you can see individual cities very easily. Right now I can see the lights of Adelaide, Melbourne, Canberra, Sydney and Brisbane, plus lots of other places — all in one view, of course, at the same time. The view is always magnificent. You can see thunder storms, you can see dust storms over the Sahara, you can see the Aurora Australis down over the Southern Pole. You can make out major land formations, river plains and cities. It's really very clear. Over...

Q. *You're up there for quite a while. I'd like to ask a few questions about how you live. What about, say, shaving? In the pictures I've seen you're clean-shaven. It would be awful to live in a fog of floating human hair! How do you keep things like that under control? Over...*

A. Oh, it takes a bit of getting used to, I guess, but I shave by holding an electric razor in one hand and a vacuum cleaner in the other! It sounds silly, but it works! Over...

Q. *Andy, what kind of food do you eat? Is the diet varied, nutritional, interesting? How do you cook or, for that matter, do you cook meals at all? And how is food stored up on Mir? Over...*

A. Ah, copy that. A good question. We use freeze-dried packaged food and some canned foods, kind of like the foods you might have on a camping trip. We re-hydrate things with hot water, and that's how we get hot foods. We have a very good selection of food, American food and Russian food, a wide variety of foods. I'm very impressed with the quality of the Russian food. I really enjoy it, too. There are some wonderful soups and juices. I have more than enough food up here — perhaps a little too much. More than I can eat in one hit; that's for sure! There's no problem about nutrition up here. It's, ah, I've probably got a better diet up here than I have on the ground. Over...

Q. *Gee, that sounds fascinating. You poor blighter, with all that choice! What about water? How do you go for such a long period up there for drinking water? Is it recycled, or do they bring a water tanker up to you? What do you do? Over...*

A. Copy that. When the Shuttle comes every few months it usually brings 1000 pounds or so of water [about 450 liters. Ed.], but we do recycle. We recycle condensate water, and use that to re-hydrate food. It's pasteurized, sterilized, and cleaned, and we use some of that to re-hydrate food. We also recycle wastewater and urine, and that's actually used in electrolysis, to break it down to hydrogen and oxygen. We breathe the oxygen, of course, it's used in the breathing air, and the hydrogen is dumped overboard. We have a sort-of-closed system, but it does come up a little bit short so it's replenished by the Shuttle flights. Over...

Q. *Now, you mentioned a treadmill when we got started, and the next question relates to exercise. It must be very difficult to keep fit. How do you do that?*

November 1998 marked the tenth year that Amateur Radio has been in operation onboard the *Mir* space station. (NASA photo)

A. Yes, that's right. You've got to work at it. The treadmill's a regular treadmill, but we use a harness over our shoulders with bungies down to the framework so it sort-of pulls us down to give us a load onto the pad. That way we get our exercise. The main thing is to get a cardiovascular work-out, as your heart's not working nearly as hard up here, and also to exercise the leg muscles, because you're not using the leg muscles at all, basically. You need to keep them reasonably healthy for the return trip. Over...

Q. *So much for the exercise sessions. You also said earlier that you work about nine or ten hours per day. So what — apart from Amateur Radio, of course — what do you do with your free time? Over...*

A. We do a fair bit of reading, and there's also the video. Of course, we don't watch TV up here — we can't get TV stations — but I like to relax sometimes watching a favorite movie or things like that. I have quite a few first-run movies, lots of books, CDs, cassettes — and Amateur Radio, of course. Over...

Q. *Pictures I've seen of Mir show something that appears to be quite large — I dunno, like a semi-trailer or a bus — although it must feel small and cramped to you. How big is it really?*

A. We have four modules on this space station. I'm in one of them now, called Piroda, which is Russian for Nature. The four modules...each one of them is about the same size as a bus, although there's a lot of equipment in them that reduces the amount of available room for us. Those are joined together at a common node, so we actually have a pretty decent amount of space when you get right down to it — certainly a lot more than the Shuttle. You do feel the confinement a bit, though, I have to admit. I wouldn't mind going for a walk along the beach right now, I must say! Over...

Q. *Yes roger, I can understand that. So what are your living accommodations like in Piroda? For those who don't know the layout of Mir, do you have much room to yourself?*

A. Oh yes, I've got a work area set up in the middle of Piroda where I've got a computer. I lay my sleeping bag on the floor when I want to sleep, I've got personal effects around there...and yes, it's really very comfortable. I've got my CDs, I've got cassettes, the computer provides me with a video screen to watch my videos on when I want to watch movies — I've got a lot of first-release movies. I also use it for e-mail...of sorts. It's not regular e-mail. I don't have a direct e-mail link, but I can send messages out through *Mir's* communication system, so I have a lot of creature comforts. It's not too bad, actually! Over...

Q. *When you're finished up there, will you be coming back to Australia for a holiday, or returning here for good, or what? You're coming down very soon, on June 1, I understand, so what will you be doing then?*

A. Well, I've got to go through a rehabilitation period. I do hope to get to Australia perhaps in September — something like that — or October, and hopefully have a nice holiday. I'm ready for a break, I can tell you that! Over...

Q. *Roger. I bet you are, and it'll be richly deserved too. Can we talk a bit now about equipment? I understand you're using a Kenwood TM-733A dual-band FM transceiver and a Kantronics KPC-9612 packet radio TNC. What sort of antenna have you got up there? I read somewhere that you have a stock standard dual-band car mobile magnetic-base antenna... but I reckon you could experience a few problems getting the coax through the door! Any ideas there? That signal is big! Over...*

A. Copy that. You got the equipment right, but I can't actually tell you what the antenna is, because it's outside and I haven't actually seen it. I really have no idea, but it's nothing elaborate, I can tell you that. It's not a big multiple array antenna, but I'm at a loss to tell you its exact geometry, I'm afraid. Over... (*Editor's Note: Dr Dave Larsen, President of MIREX, which organized the radio equipment in the first place, later confirmed the magnetic base antenna in a phone conversation. The coaxial lead goes through a special hatch for cables. The antenna was installed during a space walk several years ago.*)

Q. *Right, that makes sense. What other sorts of radio gear do you have access to up there? Obviously you can talk to the ground on your special communications channels, but what bands do you do that on, and do you use geostationary satellites to give you communications whenever you need them? Over...*

A. We've got the on-board communications system that *Mir* uses to talk to Moscow. That's ultra-high frequency — there's two channels on that one — and it's for line-of-sight comms to Moscow for our formal communications to the Mission Control Center. That's audio. There's also a telemetry signal which goes down with that, which downloads parameters of the *Mir* Space Station operational conditions, and parameters of performance and so on. We can also go through a satellite hookup, a Russian satellite, for video in addition to those when windows of opportunity permit. It's a geosynchronous satellite, and that gives video up and video down capability. But that's usually only for 25 to 30 minutes at a time. Over...

Q. *Quite a lot of electricity must be needed by such a large station, with so many power-hungry requirements. Where does your energy come from? Is it all from the Sun or are you riding in an orbiting Chernobyl? Over...*

A. No, not quite, thank goodness. The Sun provides all the power we need. Each of the modules has two large solar arrays on them, which are gimballed to keep facing towards the Sun, and each module carries an array of NiCd batteries below the floor. These get charged up during the daylight passes then we bleed that power off during the night passes — like we are right now. I can't quote you the total storage capacity or maximum current from the cells, but it's tens and tens of kilowatts. I'm not quite sure what the number is. Sometimes we do have to be a little bit cautious with power, and not to overload the system, particularly if we're at a very oblique angle to the Sun, and we're not able to capture a lot of sunlight. Over...

Q. *Andy, on the subject of the Keplerian elements, I get updated elements twice a day, and they seem to be just a little bit different every time. How often do you need to make attitude adjustments to the spacecraft, to keep it in the correct orbit, and are you involved personally in that side of things or do your Russian colleagues "drive" Mir? Over...*

A. The cosmonauts pretty much do that. We make attitude adjustments on a pretty much continuous basis, to keep an orientation that's favorable for collecting electricity from the Sun, hence the ever-changing elements. Every now and again you feel the whole station shudder as the engines fire to make a tiny adjustment. We also have a gyrodyne stabilization system — basically an array of big gyroscopes in one of the modules, which are spun up at high speed, and they also use the gyroscopic effect to maintain an inertial platform. It works very effectively because it doesn't consume propellant. Changes to

orbit... well, the orbit does decay due to the very slight atmospheric drag, but it is very slow. We only do those every few weeks, or sometimes when the Shuttle comes up we drop down the orbit to go down to meet the Shuttle. Over...

Q. *As a matter of interest, how do you navigate? Andy, how do you know where on Earth — well, above it — you are? Do you have a screen I guess like what I'm looking at here, showing you where you are in space? Over...*

A. Copy that. Yes, that's exactly what we've got. We use the very same Keplerian elements you do to tell us where our ground track is. Of course, we're moving under the effects of orbital mechanics, so it's a very stable piece of physics that keeps us spinning around the Earth. We use sensors to orient ourselves towards the horizon, to determine where the horizon is, and we use infrared sensors for that. So we can orient ourselves relative to the Earth any way we want. We also have Sun sensors for tracking the position of the Sun, and star sensors so that we can orient relative to selected star systems. So that way can keep a desired attitude. Over...

Q. *Roger, well I guess that would have to give you any number of tracking options, and fail safes in case you fly into cloud or something... hmmm sorry! On our first chat, I asked you what you could see out the window. But do you use binoculars or a telescope to look at objects on the ground, to make them sharper and clearer, and is it true that the only man-made object visible from orbit is the Great Wall of China? Over...*

A. Occasionally I use binoculars if I want get in close and see something in detail; we've got some very big binoculars up here. You can actually see from our orbit signs of human habitation. You can see occasional roads, too. You can see, for example, a straight line scratched across the Australian Nullarbor Plain that is, of course, the railway line. If the Sun is at the right angle, you get shiny glints from the rails, as well as from rivers and dams. You certainly can see the Great Wall of China, though, plus you can see the Suez Canal, the Panama Canal. You can see quite a few road networks, and dams and things like that. It's quite a view, I can tell you that! At the moment, by the way, we're just heading up between Adelaide and Melbourne. Adelaide is very distinctive with the land jutting out into the ocean, and it's very well lit up. I can see quite a few roads I know – the Main South Road is one I can see, and the city center is very bright. Melbourne is very clear, too, and I can see a lot of roads and very bright lights there too.

Andy Thomas, VK5MIR/ (NASA photo)

Q. *I wonder if, in concluding, you might have a message for our younger readers? You have accomplished something which so many of us, including me, could only ever dream of, and most certainly did in my younger days. But we have so many bright and inquiring young minds facing an exciting future with boundless opportunity. What would you say to them?*

A. Oh yes indeed. When I was younger I looked up in the sky too, and wondered what one might find. I watched in awe as a young university student as man walked on the moon for the first time, and I do believe that you can achieve almost anything you set out to do if you are really determined to get somewhere. There will be many very fascinating opportunities for people in the future. You just have to decide what it is you want to do. You've got to set your sights on something and stick with it — have the motivation and determination to see it through. To get what you want, you cannot rely on chance to make things happen. You must make things happen yourself. Over...

Andy, once again, on behalf of all of the people who will read this account, I am most grateful to you for giving me so much of your time. I hope you don't charge by the kilometer or I'll go broke!! At your current rate of 461 kilometers per minute, our just on sixty minutes together in total comes to... almost 28,000 km. You'll be a well-traveled fellow by the time you get back — just over 88 million kilometers by my reckoning! Your passport would look pretty bulky if you needed a stamp each time you crossed an international frontier. Again, thank you very much, and we all wish you continued good luck for the rest of your journey. Cheers, mate, and a very warm G'Day from Downunder.

In concluding this report, I must mention my special thanks to a number of people. First, of course, is Dr. Andrew Thomas himself, an Australian of whom we should all be justifiably proud. As well, Andy's Dad, Adrian Thomas, Dr. Lave Larsen, N6CO, CEO of MIREX, his wife Fran Caiafa for producing the certificates, QSL cards and awards, and Claudio Ariotti, IK1SLD, who runs the official MIREX Internet Web site at *http://www.ik1sld.org/mirex.htm*

Adrian Thomas Talks About His Son

We also rang Andy's dad Adrian at home in Hackham, South Australia. It would be fair to say he's pretty proud of his son's accomplishments.

"You know, I said right at the very start that, if pride's a sin, I'm pretty sinful! My pride is justified. Andrew is a rather special person. I

had great hopes for him and he really has done well. The day he rang me to say he had been accepted for training as an astronaut, it came like a kick in the solar plexus. I think it all started when I gave him a Redstone Rocket when he was nine. You know, he still has that rocket!

"Andrew is an aeronautical engineer. As soon as he finished university in the late 1970s he went to the USA and worked with Lockheed for 20 years, finally becoming their Head Scientist. But they weren't getting much NASA work, and he'd set his heart on space research, so he went to JPL [the Jet Propulsion Laboratory] in Pasadena, and from there he applied for astronaut training. Now up in *Mir* he's doing biological science, growing cancer cells and so on.

"He's coping pretty well with it. Saturday, May 2, was his 100th day in orbit, and he was due to come back at the beginning of June, but there's currently a delay of an extra five days in the launch of *Discovery*, and that could go longer. *Columbia*, which is up now, was a fortnight late lifting off!

"You know, living on *Mir* is not something that everybody could cope with. He looks well, he's pretty happy, but I feel he really is getting to the stage that he'd like to come home.

"Actually, I'll be asking him that soon. We're having a two-way TV hookup tonight courtesy of NASA. It's our second family chat together, and this time we'll talk for an hour, in honor of it being Maggie's birthday. Maggie is his lady friend; he's not married yet.

"He'll be ready for things like that eventually. As I said, I think he's really ready to come home now. But, you know, he's well adjusted, happy, and doing what he wants to. But even so I feel he's ready to return to something approaching normality.

"Yes, Andrew will be glad to settle down after this. When he came back from STS-77 in 1996 his sole ambition was to get another flight. Then he became MIR-7. It certainly gives a new meaning to the term 'get some hours in'!

"He has now regained his Australian citizenship, and he intends to return to Australia as soon as he can, and he'll want a good rest on the ground before he goes again.

"The next program is the International Space Station (ISS). This thing is so big that it will take 45 launches to get all the parts together. They've already planned the first 10 or 11 of them, and he may well be on one of those. He would do about 10 days then come back. Another long stint would be a bit difficult.

"Having said that, you know, if they decided to go back to the moon... well, that's his ambition. If the Mars trip comes off down the track a few years he would certainly put his name forward for that too.

"Mars would be completely different. The trip would take seven months getting there, then they'd spend 550 days there, then take another seven months to get back. The reason for the long stay is that they'd have to wait so the configuration of the planets is right. Frankly I don't know if I'll see it, and neither may he.

"But of course John Glenn is going up in October — and he's 77! It really makes you think, doesn't it?"

A Post Script

(Editor's Note: As you know John Glenn "made it up" and while preparing the November/December issue of The AMSAT Journal, Chris sent me the following interesting e-mail message about his eyeball QSO with Andy Thomas, VK5MIR. I have edited his note about his visit. Keep an eye out for upcoming issues of The AMSAT Journal for additional details and photos on this eyeball QSO.)

As you would no doubt be aware, Andy recently came to Australia to see his family... okay, he came on a sponsored trip to do a lot of work, but he *did* find the time to see his family... once or twice! He stayed with his Mom in Adelaide, South Australia which about 700 miles from here.

Andy also spent a few days in Melbourne (where I live), but I didn't try to catch him then because I thought he'd be too busy to worry about a local radio ham. Anyway, a couple of days before he was due to return home (the US, I mean; he's lived there for 20 years!) I rang his Mom's number on the off chance I might catch him. I just wanted to thank him for the quite unbelievable effort and time he put into Amateur Radio while he was up there. But *still* I would not have disturbed him had it not been for a call from a friend in Adelaide who had met him at a special *Mir* luncheon for 800 people which luckily saw him placed at the same table. Evidently, Andy started yapping about this series of contacts he'd had with this magazine editor... so Steve piped up that he knew me quite well. Andy asked him to get in touch with me.

Anyway, when he answered the phone it turned out he was interested in seeing me after all. "What are you doing tomorrow," he asked me. We arranged to meet the following day at the local airport, as he was passing through. To cut a very long story short, Andy flew over the next morning, and we spent some time together in front of a video camera just yapping about our childhoods, the space race, the way it was... oh yes, and the missions and the future!

And he had a gift for me that I will treasure. I am now the *very* proud owner of a complete set of cloth badges from his mission plus the obligatory PR-type photos and stickers and the like, of course. More magazine fodder!

I repeat, he's a quite remarkable man. And yes, I have a funny feeling there's *another* story or two coming up! The January issue of *Radio and Communications* will have to carry it; I simply don't have time to prepare the rest of the December issue and write the story as well. (Remember, I do *everything* in the production of the magazine on my own!)

Anyway, I'll send you that one as well, plus some photos to go with it, when it's done.

73 from Chris ■

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Amateur Radio on the International Space Station (ARISS) Minutes of the Meeting Held at the University of Surrey, Guildford, UK

Rosalie White, WA1STO and Frank Bauer, KA3HDO

A meeting was held on 29-30 July 1998 at the University of Surrey in the United Kingdom to discuss placing and operating Amateur Radio on the International Space Station (ISS). Delegates attending this meeting were:

- Rosalie White, WA1STO, ARRL and SAREX Working Group
- Frank Bauer, KA3HDO, AMSAT-NA and SAREX Working Group
- Ian Kyle, GI8AYZ, Radio Society of Great Britain
- Ron Broadbent, G3AAJ, AMSAT-UK
- Thomas Kieselbach, DL2MDE, SAFEX, Deutscher Amateur Radio Club
- Sigi Reinhold, DL6QW, SAREX, Deutscher Amateur Radio Club
- Alberto Zagni, I2KBD, ARI & AMSAT-Italy
- Paolo Pitacco, IW3QBN, AMSAT-Italy
- Fabrizio Bernardini ex-I0QIT, AMSAT-Italy
- Masanobu Tsuji, JH2PRZ, JAMSAT & JARL
- Robin Haighton, VE3FRH, AMSAT-NA
- Matthew Bordelon, KC5BTL, NASA JSC-SAREX Working Group
- Lou McFadin, W5DID, AMSAT-NA
- Roy Neal, K6DUE, SAREX Working Group

Part-time attendees via NASA teleconference call included Joerg Hahn, DL3LUM; Ken Pulfer, VE3PU; Sergej Samburov, RV3DR; and Dave Larsen, N6CO.

In attendance observing were: Hans van de Groenedaal, ZS5AKV; Ron Parise, WA4SIR; Graham Ratcliff, VK5AGR; Will Marchant, KC6ROL, AMSAT-NA; Bill Tynan, W3XO, AMSAT-NA; Ray Soifer, W2RS, AMSAT-NA; Rainor Aigner, DG2SEQ; Juergen Aigner, DG2SAX; Don Shirreff, G3BGM, AMSAT-UK; John Heaton, GIYYH, AMSAT-UK; David Clark, G6XYA, AMSAT-UK; Robin Schofield, G3RJQ, AMSAT-UK; Peter Famberg, G0BHP, AMSAT-UK; Graham Shirville, G3GSV, AMSAT-UK; Richard Limebear, G3RWL, AMSAT-UK.

Wednesday Morning Session, 29 July 1998

Additional attendees via telecon were Dave Larsen, N6CO, US, and Joerg Hahn, DL3LUM, Germany

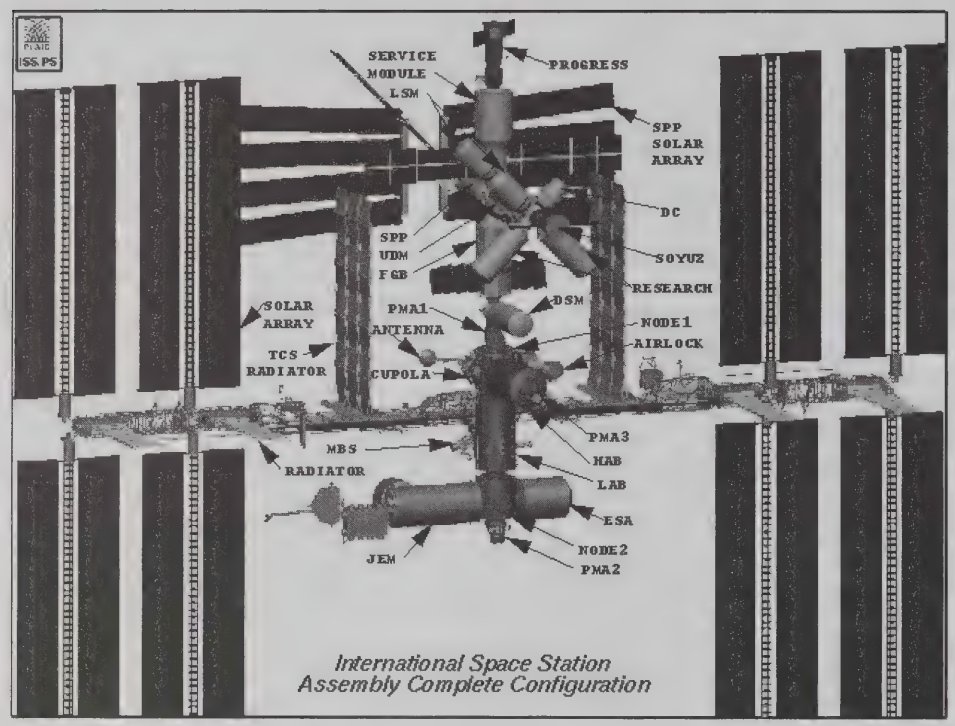
Roy Neal, K6DUE, the ARISS Meeting Moderator, welcomed everyone to the meeting, and asked all delegates to introduce themselves. The French delegates had sent their regrets, saying work obligations prevented them from taking part. Roy reported that although letters, faxes, and e-mails of invitation for this meeting had gone to the Russian delegates, they had not responded. Roy explained to the group that we would be able to keep the ARISS acronym, but that NASA wanted to continue to call us SAREX, because they have a payload named ARIS. He said that this second ARISS meeting would heavily focus on hardware, but would also cover issues such as time-sharing of the radio station, educational opportunities, etc. He then stated that one of the main purposes of our ARISS meeting was to establish a single Amateur Radio system on-board ISS. This system would be developed, operated and controlled by the ARISS international team. The primary rationale for this is to ensure that the ARISS team efficiently uses the few externally mounted antennas that are available to them. Moreover, it is the ARISS team's responsibility to ensure that ARISS hardware is qualified to fly on NASA and Russian space vehicles and that they minimize EMI and RFI concerns to NASA (since there are approximately 150 transmitting devices on the ISS). It should be noted that this Amateur Radio system would include more than just a base station — there will be interim stations, transportable stations, a permanent station and equipment mounted on the ISS EXPRESS Pallet.

ISS Status

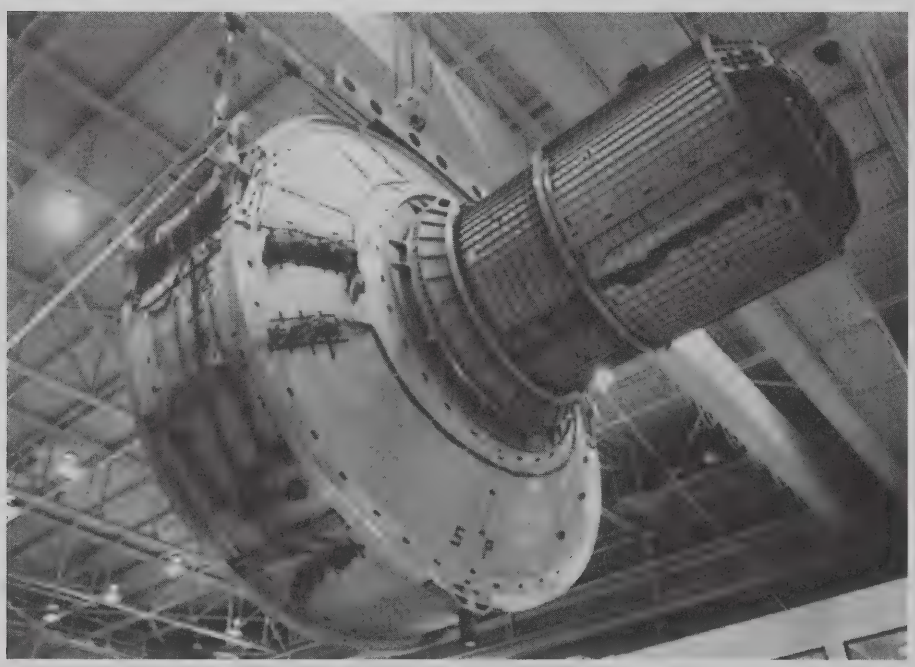
Matt Bordelon continued Roy's discussion by giving a status report on the ISS. He spoke on the ISS's assembly sequence, how ARISS was manifested onboard, how the ISS's schedule affects development and deployment (such as, space walks need to be scheduled with NASA to get antennas installed on the outside of a module). The ARISS Amateur Radio station would be initially installed inside the habitable Russian Service Module which is tentatively scheduled to be launched in April 1999 (the Service Module delivery is subject to change) with the first crew of three arriving July 1999. It will be the first ISS module with antenna feedthroughs. Additional feedthroughs may also be available on the ISS Node 3, to be built by Italy or the Habitation Module replacement. The Italian Node 3 is not expected to be launched until October 2002 and is considerably smaller than the originally planned Habitation module. A very small station could be attached by Velcro to the wall of Node 3 if antenna feedthroughs are installed.

Amateur Radio has been manifested onboard the ISS as *Necessary Crew Equipment*. As part of the discussions in

ARISS participants convened after the AMSAT-UK Colloquium at the University of Surrey. Facing the camera from left to right are Roy Neal, K6DUE; Rosalie White, WA1STO; Frank Bauer, KA1HDO; Ian Kyle, GI8AZY; and Ron Broadbent, G3AAJ. (photo by Keith Pugh, W5IU)



International Space Station assembly and complete configuration. (NASA graphic)



The airlock/crewlock is lifted by crane in the International Space Station manufacturing building at NASA's Marshall Space Flight Center in Huntsville, AL. (photo by Boeing)

Toronto, the SAREX and the SAFEX teams have been working toward getting radio equipment delivered via STS-88 (December 1998) and STS-96, Flight 2A.1 (May 1999) and the Russian team has been working on the installation of 3-4 feedthroughs on the Russian Service Module. External antennas would be mounted on these feedthroughs during an EVA which is currently planned on STS-92 (June 1999). It was discussed that prior to that date, there is no environmental (temperature) control in the modules, until the Russian Service Module goes up. The ARISS team was looking at options to fly some of the Amateur Radio equipment on the Service Module.

Interim Amateur Radio Station

Matt Bordelon also gave a talk on the plan for the interim transportable radio station that will be sent up for use early on, when the ISS flight crew is very busy integrating the ISS's modules. He explained that the SAREX team had already turned in plans for this to NASA, because they had required these several months prior to the Surrey meeting. Some of NASA's requirements include the following: the equipment must be easy to switch modes, easy to fix malfunctions, have support documentation, be safe, easy to program, easy to understand the display and easy to assemble/stow/reconfigure. Matt then gave a top-level overview of the interim station plans that came out of the fall 1997 AMSAT-NA meeting in Toronto. The interim station would be developed in two phases. Phase 1 of the Interim Station includes a 2m HT, a packet module, a RF notch filter, an adapter module and cables. Phase 2 of the Interim Station includes a 70 cm HT, an adapter module, cable for dual-band operations and the SAFEX digi-talker.

Transportable Amateur Radio Station

Thomas Kieselbach then gave a presentation which showed a Kenwood radio (uplink on 70 cm, downlink on 2m), capable of doing crossband, voice, and operating as a full duplex repeater. He stated that, if selected, two radio systems would be required, one for voice and one for packet. He demonstrated the digi-talker that the SAFEX team is developing for the interim station (it could send messages to the ground, resulting in good public relations). He also presented Germany's ideas for packet, voice, SSTV, FSTV and beacons, using the Kenwood radio. The ARISS group discussed whether ISS officials could

flight-certify a Kenwood, and how it would have to be modified to pass safety tests of flammability, over-heating, heat transfer, RFI and EMI.

The next presentation was given by Lou McFadin and Will Marchant. This presentation provided a more detailed description of the interim transportable station hardware plans resulting from talks held at the AMSAT-NA Symposium in Toronto last Fall. This station would consist of 2 m and 70 cm handheld transceivers for FM voice, a German-developed digitalker beacon, and a 1200 baud AFSK terrestrial packet TNC (crew e-mail, beacons, APRS digipeating). This setup would provide basic voice and packet capabilities until more advanced facilities are available and then it can be used as a back-up station. This station will allow the crew to talk to the ground for school educational QSOs, crew personal QSOs, outreach to the ham community with general QSOs and emergency communications. Roy Neal described the new Kenwood SSTV system that was recently unveiled at the Dayton Hamvention. He stated that this system could be used on any of the Interim and Transportable station designs that were presented. He also stated that Kenwood is very interested in working with the ARISS international partners to make this hardware part of the ARISS station.

Permanent Amateur Radio Station

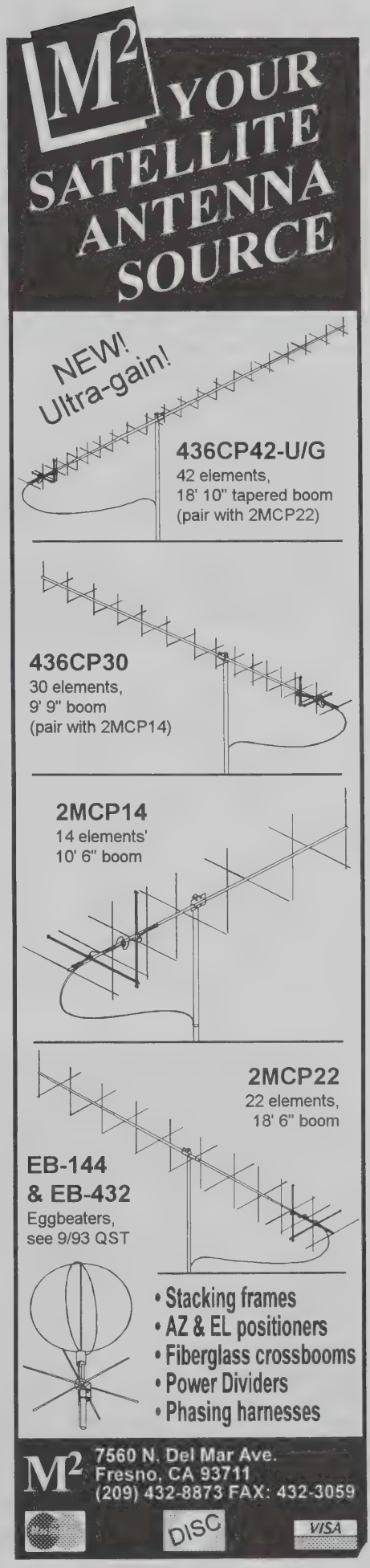
Lou McFadin described the U.S. proposal for the permanent Amateur Radio station. This uses the DSP-based Kachina computerized hardware. The Kachina can control off-the-shelf and specially-built transmitters and receivers. A system using the Kachina could include FM and SSB operations with uplinks on 10m, 2m, 70cm, 23cm and 13cm, and downlinks on 10m, 2m, 70cm, 13cm, with room for future expansion. Its modular design is easily expandable, portable, offers dual/crossband capability, and uses 10m as the IF. It can have TNCs, SSTV and digital voice memory modules connected to it. It can be software-based/controlled, but requires a laptop computer for a user interface.

Access can be limited if need be, via software. It can also provide a simple, easy interface to the crew. The system could be connected to the ISS's audio/video system. Hams in partner countries could provide the audio interface modules, controller interface module and software, packet software, RF switching and coupling module, power supply, internal and external wiring, wireless remote stations and integration and configuration control. Ground controllers could send commands to the hardware while the crew is sleeping, such as to turn on the digipeater. However, funding is more of a problem with this system than if we used only off-the-shelf transceivers, since the Kachina company cannot afford to give us six systems at no cost.

Italy discussed their plans, and showed a unit they had built. They believe that the approach for ISS equipment should be modular, with a bus structure, single module layout and interface, using CPU control. Their plans included a touch screen set up to do work via NASA or ARISS-supplied computers. Their proposal relied primarily on amateur construction projects as compared to modifying or adaptimg commercial off-the-shelf radio equipment. Matt Bordelon presented viewgraphs that he created after receiving a fax from the Russian team several weeks ago. As Matt went through the viewgraphs, delegates discussed the Russian's suggested frequencies (23cm, 70cm, 2m, 10m, 15m and 20m!). The hardware would provide voice, data, SSTV, FSTV and access to ISS emergency communications channels. The Russian proposal stated that Russia would provide four unallocated RF feedthroughs on the Russian Service Module and that they would finish all necessary work on the feedthroughs if NASA requests it in a contract. Sergej Samburov also offered to install and configure the equipment (radios, antennas, computer, packet modem and cables), but these had to be supplied by other countries. Matt stated that he has been trying to work the issue of getting a contract between NASA and the Russians through Team 0 Protocol. He pointed out that no EVAs have yet been scheduled to install/adjust/test antennas – EVAs for antenna installation would be scheduled during EVAs for other tasks. He also stated that we need more details from Russia on the location and description of the feedthroughs and interfaces — but Sergej cannot provide this until the Team 0 protocol contract is in hand. It should be noted that NASA has raised some issues with the ARISS plans to use the 2.4 GHz band.

Express Pallet

Will Marchant and Matt Bordelon then discussed the concept of development and installation of external payloads using the EXPRESS Pallet, which provides externally-mounted opportunities to install



Amateur Radio payloads on ISS. The EXPRESS Pallet is to be launched February 2002. ARISS is to share its 1m by 1m space with a JPL Laser Communications Experiment. The SAREX team has recently networked with engineers at the Jet Propulsion Lab on ideas for each of us to maximize our combined Pallet opportunities. Thermal issues are of great concern to payloads on the Pallet. Ideas discussed for using the Pallet included a repeater system, a microsat, or yet-to-be-determined Earth science experiments that provide Amateur Radio telemetry and data downlinks. Integration of the Pallet would be done at Kennedy Space Center nine months prior to launch, and would cost about $100,000. NASA requires a minimum of six identical systems to be used for such things as flight-qualification testing, development, installation, training, etc. Hardware costs are the cheapest part of everything that is required. The Germans suggested that they could successfully go to their government and the EC educational funds for a grant (they have done so previously).

Miscellaneous

Although hams are our customers, everyone at the meeting agreed that education is *the paying customer*. Therefore, ARISS must develop activities that will excite teachers and students. ISS management and the ISS crewmembers are also customers. Rosalie White stated that although hams are not paying customers, they will be the ones who excite the teachers and the students to take part in ARISS-type activities, and so, are also our customers.

Wednesday Afternoon Session, 29 July 1998

An additional attendee via telecon was Joerg Hahn, DL3LUM, Germany. Roy Neal suggested that the delegates adopt the idea of having an Administrative Committee and a Hardware Committee to focus on specific ARISS matters. The administrative committee will support and further causes such as station operations, fundraising, third party traffic, and frequency selection. The technical committee will concern itself with matters such as Flight hardware development, integration, testing and on-orbit validation of the flight hardware. This idea was unanimously endorsed by the ARISS delegation. A short discussion was started by Thomas Kieselbach on how delegates representing the partner countries must be from their own country. Every delegate ardently agreed. Also discussed was the need for the delegates to ensure that hardware flown on ISS is endorsed by the ARISS team and meets all the flight quality standards that NASA is demanding. Delegates unanimously voted that there must be only one permanent station, and that the equipment will be owned by ARISS. Moreover, any hardware delivered for flight should include all the safety and testing paperwork that demonstrates that the hardware is flight-ready and it should also include a letter of endorsement from the ARISS partner-country signed and approved by the two delegates from that country.

There was a great deal of discussion on merging the various hardware proposals into one cohesive package. A delegate suggested that ARISS needs a set of *Mission Requirements* to communicate to the ISS management. Frank Bauer displayed a viewgraph of the requirements that the US delegation has presented to the ISS managers. These include:

- opportunities for educational activities,
- experimental communications,
- ham and general community outreach,
- a method for crews to maintain contact with family and friends (crew psychology factors), and
- a backup communications link for emergencies. Amateur Radio is an additional communications capability to the crew, especially when the crew first arrives.

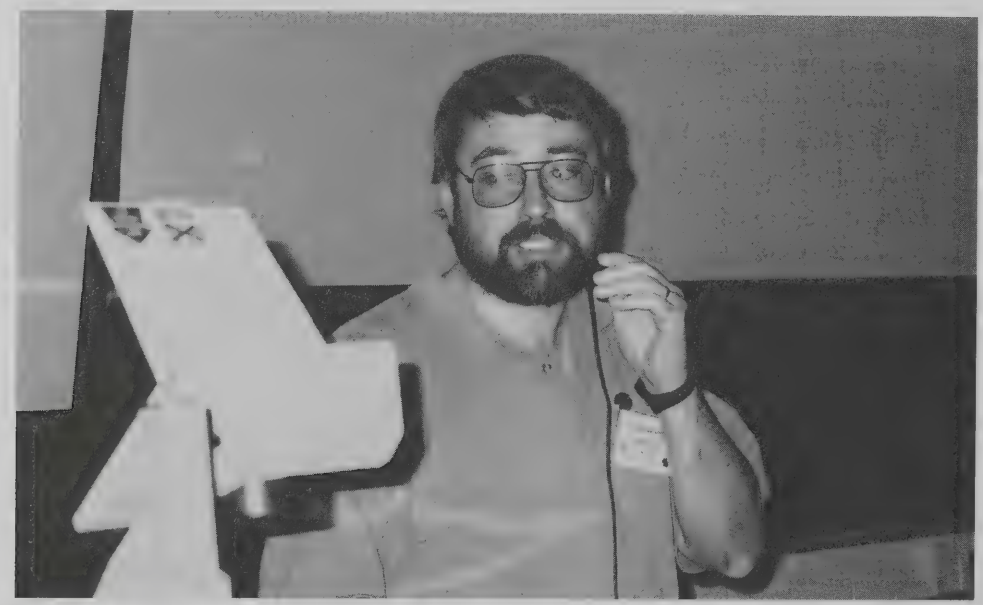
They can easily use an interim station consisting of HTs and a TNC. Delegates felt these requirements were suitable for ARISS. The delegates reviewed a long list of hardware requirements for the ISS radio equipment (i.e. a suitable amount of mass and volume for the ISS, generates a telemetry stream in order for us to monitor operational and engineering health, is controllable from the ground, allows a continuous downlink, is easy to reconfigure, meets ISS safety requirements, can be easily upgraded, etc.) The discussions and discussions held the following days led to the development of an ARISS mission statement which is included at the end of these minutes.

The first day of meetings ended at 6 PM, and delegates met for dinner at the cafeteria for informal discussions.

Thursday Morning Session, 30 July 1998

Additional attendees via telecon were Joerg Hahn, DL3LUM, Germany, and Sergej Samburov, RV3DR, Russia;

Joerg informed the delegates that Sergej Samburov, RV3DR was requesting attendance by telecon to the ARISS meeting this morning and he faxed a proposal for the Russian station contribution to Joerg. This was subsequently faxed to the ARISS delegates in Surrey studied, and discussed. Matt Bordelon stated that this proposal appeared to be an elaboration of the Russian proposal that he presented the day before. There was some discussion regarding the wording in the proposal that an independent Russian Amateur Radio station was going to be produced. All the delegates present expressed concern regarding this since it violated our *Single Amateur Radio System*



Will Marchant, KC6ROL discussing interim transportable station hardware. (photo by Ray Soifer, W2RS)

concept that is an integral part of the MOU with NASA. Many felt that this was a language barrier issue that could be discussed with Sergej. Sergej was brought on-line and Russian station contributions were discussed. Since Sergej was not able to attend the ARISS meeting in person, Thomas Kieselbach suggested that a 2 person delegation go to Russia to get Sergej filled in on the Surrey meeting results (including hardware requirements, station ops, etc), the results of the NASA Team 0 protocol, and to discuss the ARISS team's concerns regarding an independent Russian Amateur Radio station. The delegates unanimously agreed that Matt Bordelon, KC5BTL and Joerg Hahn, DL3LUM, should go to Russia to reperesent the ARISS international team. Sergej welcomed this idea and will work with the delegates to select a date for the meeting.

The countries present at the meeting were then polled to identify one administrative and one hardware committee representative. The following representatives were selected to serve on these committees with the understanding that these representatives can be changed if the country's delegates determine that this is required.

Hardware Committee:

- US - Lou McFadin, W5DID (chairman)
- UK - Ian Kyle, GI8AYZ
- Germany - Sigi Reinhold DL6QW
- Italy - Paolo Pitacco, IW3QBN
- Japan - Masanobu Tsuji, JH2PRZ
- Canada - Robin Haighton, VE3FRH

Administrative Committee:

- US - Frank Bauer, KA3HDO, Rosalie White, WA1STO (Alternate)
- UK- Ron Broadbent, G3AAJ
- Germany—Thomas Kieselbach, DL2MDE
- Italy - Alberto Zagni, I2KBD
- Japan - Masanobu Tsuji, JH2PRZ
- Canada - Ken Pulfer, VE3PU

The delegates then broke for lunch.

Thursday Afternoon Session, 30 July 1998

To derive the most from the delegate resources present at the meeting and to get back on schedule, a change to the agenda was suggested and approved. Two simultaneous breakout meetings were held: an administrative meeting and a hardware meeting. The delegate representatives to the hardware committee attended the hardware session. The delegate representatives to the administrative committee attended the administrative session. The agenda for the administrative meeting included discussions on Station Operations & Education, ARISS Callsign, Fundraising and Crew Training.

The hardware meeting included discussions on hardware schedule, specific deliverables to proposed Shuttle-ISS flight opportunities, and transportable and permanent hardware development responsibilities. Frank Bauer, KA3HDO facilitated the administrative meeting discussions and Lou McFadin, W5DID chaired the hardware meeting.

Teleconferencing services were impractical for this portion of the discussions. The delegates prearranged to teleconference the additional parties at 14:30 UTC. At 14:30 UTC (15:30 local time) the results of these meetings were reported back to the full delegation with the following people teleconferenced into the meeting: Ken Pulfer, VE3PU, Canada, Joerg Hahn, DL3LUM, Germany, Dave Larsen, N6CO, US, and Sergej Samburov, RV3DR, Russia. A summary of the two meetings follow:

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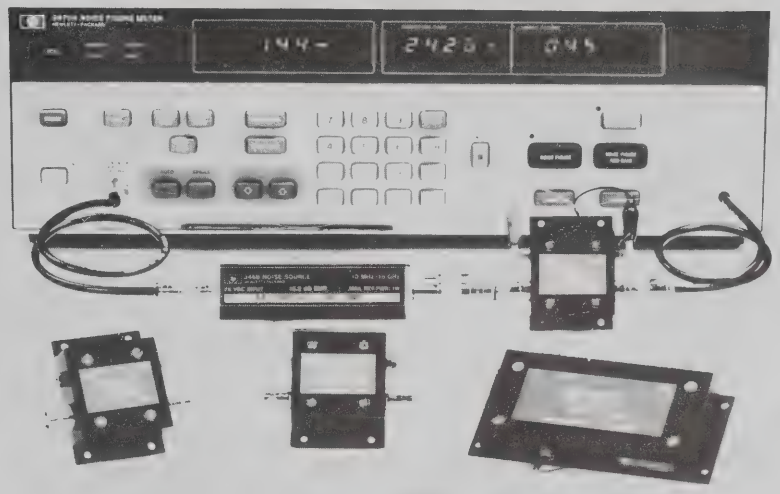

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P220VDA	220-225	<1.2	15	0	DGFET	$37.95
P220VDG	220-225	<0.5	20	+12	GaAsFET	$79.95
P432VD	420-450	<1.8	15	-20	Bipolar	$32.95
P432VDA	420-450	<1.1	17	-20	Bipolar	$49.95
P432VDG	420-450	<0.5	16	+12	GaAsFET	$79.95
Inline (rf switched)						
SP28VD	28-30	<1.2	15	0	DGFET	$59.95
SP50VD	50-54	<1.4	15	0	DGFET	$59.95
SP50VDG	50-54	<0.55	24	+12	GaAsFET	$109.95
SP144VD	144-148	<1.6	15	0	DGFET	$59.95
SP144VDA	144-148	<1.1	15	0	DGFET	$67.95
SP144VDG	144-148	<0.55	24	+12	GaAsFET	$109.95
SP220VD	220-225	<1.9	15	0	DGFET	$59.95
SP220VDA	220-225	<1.3	15	0	DGFET	$67.95
SP220VDG	220-225	<0.55	20	+12	GaAsFET	$109.95
SP432VD	420-450	<1.9	15	-20	Bipolar	$62.95
SP432VDA	420-450	<1.2	17	-20	Bipolar	$79.95
SP432VDG	420-450	<0.55	16	+12	GaAsFET	$109.95

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Administrative Meeting: Station Operations & Education

The Administrative team discussed and agreed to the idea of an ARISS Operations Board/Working Group. The idea of choice was to use the AMSAT Phase 3D operations board as a model since it has been so successful. Members of the SAREX Working Group discussed some of the problems that happened early in their program and their need for a set of rules or guidelines to ensure that the SAREX program is balanced from an operations perspective and to prevent issues that were occurring between the SAREX team, the astronaut community and NASA. The ARISS team agreed that it would be prudent to look at the SAREX Guidelines as a starting point to ensure that the program is balanced and to prevent issues that may occur between the ARISS Community, the flight crew and the International Space Agencies (e.g. NASA). It was agreed that there will be two types of Amateur Radio operations on ISS—flight crew-tended and automatic operations. It was also agreed that ARISS needs to have a balanced operations program which includes:

- School Group Contacts
- Experimentation
- Family/personal contacts
- General QSOs

Actions

- Define members for ARISS Ops Board
- Work to develop an operations plan—this would include a set of guidelines that would be given to the flight crew, ARISS delegates and ISS officials
- Define school group selection process

ARISS Callsign

Thomas Kieselbach suggested the use of a special set of United Nations callsigns. These include:

- 4U1S Primarily for Voice Operations
- 4U1ISS for Automated Operations (Packet, SSTV, Digitalker)

This idea was unanimously accepted by the administrative team. Since ARISS is not an international organization, we discussed different alternatives to obtain the above set of callsigns. It was concluded that IARU sponsorship of above callsigns is the best approach.

Action

- Hans van de Groenedaal, ZS5AKV took an action to write a position paper on the callsign proposal and to work with Larry Price (ARRL/IARU) to bring the idea to the United Nations

Fundraising

The ARISS team will need funding for hardware development and to assist delegates with expenses of attending meetings. It was suggested that the ARISS team study the Phase 3D fundraising plan where the fundraising is accomplished locally (in each country) and the funding of projects is managed by a multi-national, multi-organizational Phase 3D finance team. This locally administered, centrally managed fundraising model is expected to work well for ARISS and was recommended as the best choice for ARISS fundraising and distribution. Even non-partner countries can raise money, since they'll want to take part in the educational activities. The need for a budget was discussed with specific milestones to meet. Also discussed was the need for the development of an ARISS fundraising package that provides significant incentives for people and organizations to donate to the cause. Educational outreach should be in integral part of this sales package. Rosalie White volunteered to share grant paperwork for anyone who is interested. She was also asked to determine how ARRL would feel about administering a trust for the US, or even for the entire world, if ARISS asked the ARRL to do so.

Actions

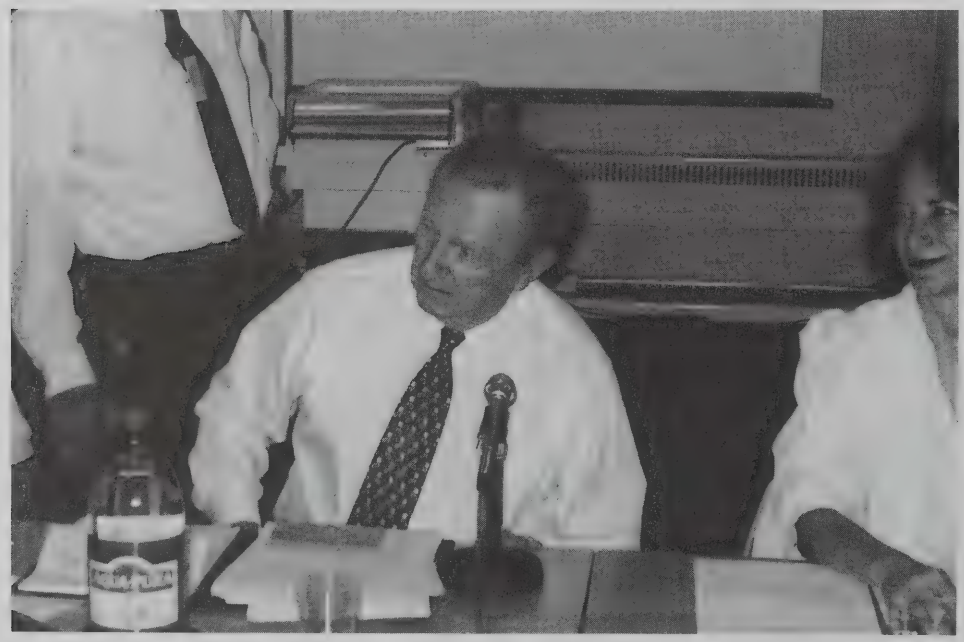
- Administrative team and hardware team should develop an ARISS budget with specific development milestones included.
- Rosalie White to share grant paperwork to those interested
- Develop a fundraising *sales* package to enable the solicitation of donations with ARISS

Crew Training and Initial Planning for School Group Activities

Rosalie White chaired this portion of the meeting while Matt Bordelon listed the types of training that are presently done with the crews. Rosalie also gave a presentation, which outlined various rules that the ARISS station needed to adhere to. These included ensuring that the ISS Amateur Radio station is not operated for personal gain or profit, for political reasons, or for the benefit of one particular country or entity. Rosalie also covered how SAREX makes their school selections, and what the SAREX Working Group requires schools and communities to accomplish to ensure the contact provides a maximum benefit to the students, the community and to NASA. She also described the SAREX school application process and what NASA requests as part of this process.

Time Sharing and Allocation of Station Use

Rosalie White gave a presentation on time-sharing of the station. The main point of the presentation was that ARISS needs a system to govern time, and that there should be an ARISS working group to study how such a governing body could work, and what guidelines could be set up. A Station Traffic Manager (possibly on Earth) could schedule time, and a Station Management Team could work with that manager. Other delegates



ARISS Chairman Roy Neal, K6DUE and Rosalie White, WA1STO (photo by Ray Soifer, W2RS)

suggested a few ideas, but agreed with the thought of an ARISS Operations Board (such as the Phase 3D model), defined by the ARISS delegates, to coordinate time-sharing. Delegates suggested that the future Operations Board could go by the SAREX guidelines. Additional guidelines will allow the general ham to get enough on-the-air time with crewmembers. Also discussed was the need for ARISS to not allow any political-type QSOs (governors, senators) other than to give their greetings to students.

Hardware Meeting

The hardware meeting was chaired by Lou McFadin, W5DID. During this meeting, the members discussed plans for station hardware to be housed in the pressurized modules. Specific discussions on the Express Pallet, beyond the presentation by Will Marchant and Matt Bordelon, were tabled for a future meeting. The hardware team concluded that ARISS hardware should be developed in three phases. These include the following station configurations:

- Interim Amateur Station
- Transportable Amateur Station
- Permanent Amateur Station

The following represents their finalized ideas for implementing the three ISS phases as well as a description of the roles and responsibilities of each country:

Interim Amateur Station Phase 1 - *First Flight Opportunity STS-88 December 1998*

Hardware planned:

- Improved Packet Module
- Ericsson 2m Radio
- New Adapter Module
- RF Notch Filter
- Associated Cables
- Antennas

Interim Amateur Station Phase 2 - *Second Flight Opportunity STS-96 May 1999*

Hardware planned:

- Ericsson 70cm Radio
- New Adapter Module
- Cable for Dual Band Ops
- Digitalker
- Associated Cables

Transportable Amateur Station - *Flight Opportunity STS-98 or 99 Late 1999*

Integrated hardware package containing:

- Dual Band Mobile Transceiver
- Power Supply
- Digitalker
- Paccomm Pico TNC
- Audio Signal Conditioner
- Speaker

Permanent Station

(Flight opportunity – to be decided

Features – In process – To Be Decided

Tasks :

Interim Station

- USA: Packet Module, Adapter Module, Radio, Associated Cables, Integration, Safety Data Package
- Germany: Digitalker Antenna Interface Information
- Italy: Antenna Design and Fabrication
- Russia: Install necessary RF cables & antennas
- Others: Assist as possible

Transportable Station

- USA: Packet TNC, Integration, Safety Data Package
- Germany: System Design and Fabrication
- Others: Assist as possible

Permanent Station

- USA: Flight Safety Package
- Other: Tasks – to be decided and determined by final design

Re-Convening

Additional attendance via telecon: Ken Pulfer, VE3PU, Canada; Joerg Hahn, DL3LUM, Germany; Dave Larsen, N6CO, USA; and Sergej Samburov, RV3DR, Russia.

At 3:30 pm, all delegates re-convened to report on their discussions. Frank Bauer started by reviewing the notes from the administrative discussions (above), Rosalie White covered school activities and crew training (above) and Lou McFadin gave a report from the Hardware Group (above). This is where the most successful aspects of the meeting occurred in that the delegates were all working as one cohesive team. The meeting continued with a discussion on frequencies. The meeting wrapped up by assigning Rosalie White and Frank Bauer the responsibility of composing the meeting minutes.

Frequency Discussion

The entire group then discussed frequencies. This was led by Frank Bauer and Thomas Kieselbach, who had worked on this issue in Toronto during the 1997 AMSAT-NA Symposium. The group discussed at length past problems with frequencies used in space. Frank described the history of the APRS move. Hans Van de Groenedaal, ZS5AKV, Graham Ratcliff, VK5AGR, Ray Soifer, W2RS and Bill Tynan, W3XO, were invited to participate in these discussions. Hans agreed to take a proposal based on the ARISS delegates' discussions, to the IARU prior to their upcoming meeting.

ARISS Mission Statement

- *Shall have the capability to provide space-to-ground Amateur Radio communication for the ISS crew and for educational purposes.*
- *Shall have the capability also for unattended operation for control, experimental and other purposes within the Amateur Radio Service. Equipment must be sufficiently adaptable to accommodate the diverse range of modes and frequencies envisaged in present and future educational and other experiments.*

To follow further developments on Amateur Radio on the International Space Station monitor the ARISS WWW site at: *http://garc.gsfc.nasa.gov/~ariss/ariss.html*■

AMSAT Journal Telemetry

Request for Amateur Radio Package: MOST Satellite

AMSAT-NA in cooperation with the University of Toronto Institute of Aerospace Studies (UTIAS), Dynacon Enterprises Inc., and the Canadian Space Agency, has the opportunity to launch an *Amateur Radio Package* on the Microvariability and Oscillation of STars (MOST) satellite (see *The AMSAT Journal*, Jan/Feb 1998). The expected launch date is November 2001. This notice requests Radio Amateurs or Radio Amateur Groups to provide an initial *Statement of Interest* in providing this package. Anticipated (maximum) parameters are:

- **Mass:** 2Kg.
- **Power:** 2 Watts continuous.
- **Dimensions:** One circuit board or about 525 sq cm by 25 mm
- **Stabilization of Spacecraft:** Stellar Inertial
- **Orbit:** Low Earth Orbit - Sun Synchronous - near polar - 6am/pm.

Initial Statements of no more than half a page (8.5 x11) should be e-mailed to *ve3frh@amsat.org* or by postal mail to Robin Haighton PE, 2028 Cheviot Court, Burlington, Ontario, Canada. L7P 1W8. Statements should arrive no later than 26 November 1998. A review of initial Statements by AMSAT-NA and UTIAS will take place before 31 December 1998 and participants will be notified shortly thereafter of their status.

27th Annual SKN on OSCAR

You're most cordially invited to join in the 27th annual Straight Key Night (SKN) on OSCAR, sponsored by AMSAT-NA for Amateur Radio satellite enthusiasts worldwide.

It's entirely unofficial: no rules, no scoring and no need to send in a log. Just call CQ SKN in the CW passband segment of any OSCAR satellite from 0000 to 2359 UTC on January 1, 1999, or answer a CQ SKN call from another station. OSCAR Zero (EME) contacts count too. Of course, all SKN operating must be done with a straight hand key.

Those participating are encouraged to nominate someone they worked for recognition as having the *best fist*. To send in a *best fist* nomination, please address it via e-mail to *w2rs@amsat.org*, via packet radio to W2RS @ WA2SNA or W2RS @ GB7HSN (whichever is closer to you), or via postal mail" to W2RS' callbook address. Those nominated will be featured in a bulletin sent to Amateur Radio publications and posted via ANS to packet radio and the Internet in early February 1999.

RS-18 Released from *Mir*

AMSAT-France announced on 27 October 1998 that a new model of the original Sputnik satellite (Sputnik 41) was transferred to *Mir*. On 10 November 1998 RS-18 was released by hand from *Mir* during an EVA. This satellite is part of the same French school program that built RS-17 in collaboration with Russian schools. The satellite was financed by the *Aeroclub de France* to commemorate their 100th birthday. Technical characteristics of RS-18 are:

- **Size:** 20 cm diameter (same as RS-17)
- **Weight:** 3.5 kg.
- **TX:** 150 mW with 4 circularized antennas
- **Frequency:** 145.8125 MHz FM +/- 5 KHz +/- Doppler.
- **Expected Life:** Between 20 and 30 days (no solar cells).
- **Messages:** Every ten seconds RS-18 cycles a five-second message. There are two recorded messages read in French, English and Russian for a total cycle of nine recorded messages:

1. French Message: *1998 etait l'annee internationale de l'air et de l'espace.* Read by Aurelie Boivin, 12 year old, daughter of F6CWN and F6IFR.

2. English Message: *1998 was the International year of Air and Space.* Read by Constantin Tsiolkvosky-Sambourov, 14 year old, great-grandson of Tsiolkvosky inventor of rockets and son of Sergej Sambourov, RV3DR.

3. Russian Message: Read by Michael Tsiokvosky-Sambourov, 12 years old.

4. RS-18 Telemetry (tone)

5. French Message: *Programme spatial international de satellite educatif.* Read by Gerard Auvray F6FAO, AMSAT -France.

6. English Message: *International Space School Sputnik Program.* Read by Victor Kourilov, Project Manager.

7. Russian Message: read by Sergev Sambourov, RV3DR, grandson of Tsiokvosky and responsible of the Amateur Radio activity on *Mir*.

8. French Message: *Programme spatial international de satellite educatif.* Read by Gerard Auvray F6FAO, AMSAT -France.

9. RS-18 Telemetry (tone)

Fly Your QSL on Phase 3D

AMSAT would like to thank the following people for their donation to *Fly Your QSL on Phase 3D* project:

- George S. Anton KA6NBA
- Fred W. Atkinson, III WB4AEJ
- Barry A. Baines WD4ASW
- Ed Baker W6TWN
- Keith Baker KB1SF
- Jon Mitchell Beaver KD4AMP
- Dexter Berwald K2SBQ
- Joseph Betros KB0QHZ
- Bill Briles W0OQC
- Larry Brown NW7N
- Dorothy J. Burden KA1LDS
- William Burden WB1BRE
- Douglas C. Burke WA4LKX
- Barr Canario WH6CXO
- Mark Casciato KC5FP
- Bill Caton WD4DHJ
- Ken Chaffee WA1QXR
- Morr Cohan KA1IU
- Douglas Cole N7BFS
- Ward Culbertson N0EFW
- Raymond W. Czyzewski, Jr WA2SEI
- Robert Davis, KD4QEM
- Ken Ernandes, N2WWD
- Yoshio Esaki JA6BX
- Don Ferguson KD6IRE
- L Clare Fowler VE3NPC
- Mike Freitag W9GYC
- Stephen D. Fuegi N3ZJA
- Charles Glasford KA7LVY
- Thomas G. Griffin Jr. KR2C
- Robert H. Gundlach N3NBT
- Reidar "Ray" Haddemo SM7ANL
- Bennie A. Hall WY4D
- Raymond F. Hoad WA5QGD
- Doug Howard KG5OA
- Charles Huffman W4LYZ
- Rodney E. Hunter K7ROD
- Jim Jerzycke KQ6EA
- David Jones KI5OS
- Jim L. Jones K5PER
- William A. Jones AA9TX
- James Kauten W4TE
- Ken Kelley WA7JQE
- Jim Kelly KK3K
- Charles Keng N5XGW
- Hiroyuki Kitamura JH3TXF
- Robert Krebs, KA2HDD
- Doug Kuitula KA8QCU
- Rick Largent N5ZNL
- Mike Lowe KB9MGX
- Andy MacAllister W5ACM
- Kitty Marosko K5KAT
- Ron Marosko K5LLL
- Thomas W. May KC5DHE
- Gary "Joe" Mayfield KA0YOS
- Lou McFadin, W5DID
- Craig T. Mellinger N2MNA
- Charles Mesak W6FVJ
- Ken Miller N1NRL
- Richard M. Montgomery N3DV
- Milo Moucha W4TIJ
- Dennis R. "Doc" Murphy K0GRM
- Steven C. Obenhofer N2ULL
- Walter G. Obenhofer NQ2O
- Yoshimitsu Otani JH4DHX
- William Phillips KB8SWX
- Kathy Prindle N3MHQ
- Ron Prindle N3BXL
- Keith Pugh W5IU
- Douglas D. Quagliana KA2UPW
- Jacques Rambaud F6BKI
- Alan P. Rothermich WB0QLU
- A. Terry Schieler W0FM
- Richard T. Sell N9MYK
- Kasai Shigekazu WU1R
- Klaus Stengel CE5NG
- Wallace F. Strow, Jr. WA9RNE
- Neal H. Swenor KA1SAW
- Stephen Thompson K5PK
- Terrell Thompson KB6CUT
- Larry Toulch VE2ME
- Keiichi Tsurumi JA1JRZ
- Bill Tynan W3XO
- Chris L. Vogt N0MTO
- Farrell Winder W8ZCF
- Fumihiko Yoshimachi JA1BLC
- John B. Young WD0FPY
- Yves Zinck F9ZY
- Joseph EB3GFG

QSL cards provided by the above members will be digitally scanned onto a CD ROM that will be attached to the Phase 3D space craft. If you would like to fly YOUR QSL on Phase 3D there is still time to get your card on the CD ROM. Please contact AMSAT-NA (301-589-6062) for details.

- **Telemetry:** Audio frequency versus internal temperature where:

-38C = 179 Hz
-30C = 273 Hz
-20C = 440 Hz
-10C = 634 Hz
+ 0C = 830 Hz
+10C = 1025 Hz
+20C = 1200 Hz
+30C = 1308 Hz
+40C = 1405 Hz
+45C = 1447 Hz
+50C = 1483 Hz

For additional details on RS-18 see *http://www.ccr.jussieu.fr/physio/f6bvp/*

SEDSAT and PANSAT Launched

SEDSAT-1: Students for the Exploration and Development of Space Satellite number one (SEDSAT-1), was successfully launched and placed in orbit on Saturday, 24 October 1998. The spacecraft flew as a secondary passenger along with the Jet Propulsion Laboratory's Deep Space One mission aboard a Delta II booster. SEDSAT-1 includes Amateur Radio configurations for digital packet store-and-forward, analog parrot repeater and Mode A and Mode L transponders. During orbit day 2, Chris Lewicki, KC7NYV, the Program Manager for SEDSAT-1, announced that two of the primary systems, solar panels and batteries, were not performing to specifications, "and sometime around orbit 22, the satellite went power negative, and the power cycled." Mark, KF4YGR, told ANS that the software on SEDSAT is configured to save power if the satellite goes into a negative voltage status, "but it keeps communications up preferentially. Thus the ability to manage power is limited by the consumption of the receiver subsystems." KC7NYV, reports that the SEDSAT Team immediately discussed a number of options to answer the problem, "but the primary objective is to establish an uplink to the satellite and upload the new code necessary to allow changes in the flight parameters. Once the new code is uploaded, we basically will put the satellite into a more aggressive power conservation mode," said KC7NYV. Many AMSAT members worldwide responded to a call for SEDSAT telemetry so that the Command team could analyze information from several complete orbits. N8DEU, KB2WQM, N2WWD, CT1EAT, G3RWL, K5NRK, KD2JF, G0ORX, WA4SCA and JE9PEL, (among many others), offered help and/or funneled received data to the team. KC7NYV reports that once an uplink is established, the first priority will be to enable a more lengthy charging cycle, followed by an imaging session and download. Chris estimates that the satellite will take slightly over 24 hours to charge up to full capacity while in the power-save mode. KC7NYV says what will likely happen is the satellite will be put in a mode "where it doesn't operate for a day as it charges, then operates for two days, then a day to charge and so on." Stay tuned to ANS and amsat-bb for further developments concerning the status of SEDSAT-1.

PANSAT: PANSAT was successfully released from *Discovery's* cargo bay (STS95) at approximately 1747UTC, 30 October 1998. *Discovery's* location at the time of deployment was the northwest corner of Australia at an altitude 345 statute miles. PANSAT was built and commanded at the Naval Postgraduate School in Monterey, CA. The spacecraft provides store-and-forward (packet radio) digital communications using direct sequence spread spectrum modulation. PANSAT operates in the amateur radio 70 cm band with center frequency at 436.5 MHz, a bit rate of 9842 bits per second and 9 MB of message storage. Amateur radio ground stations will be able to use PANSAT via a bulletin-board type user interface. Additional information on PANSAT can be obtained via *http://131.120.25.103/pansat/*

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Over eight years ago, we introduced our famous SP-2 and SP-70 *SUPER-AMPS*. We are now proud to introduce the SP-2000 and the SP-7000 --- a new generation of SSB Electronic 2 meter and 70cm mast mounted GaAsFET preamplifiers for Satellite, Weak Signal, Tropo, EME and ATV!

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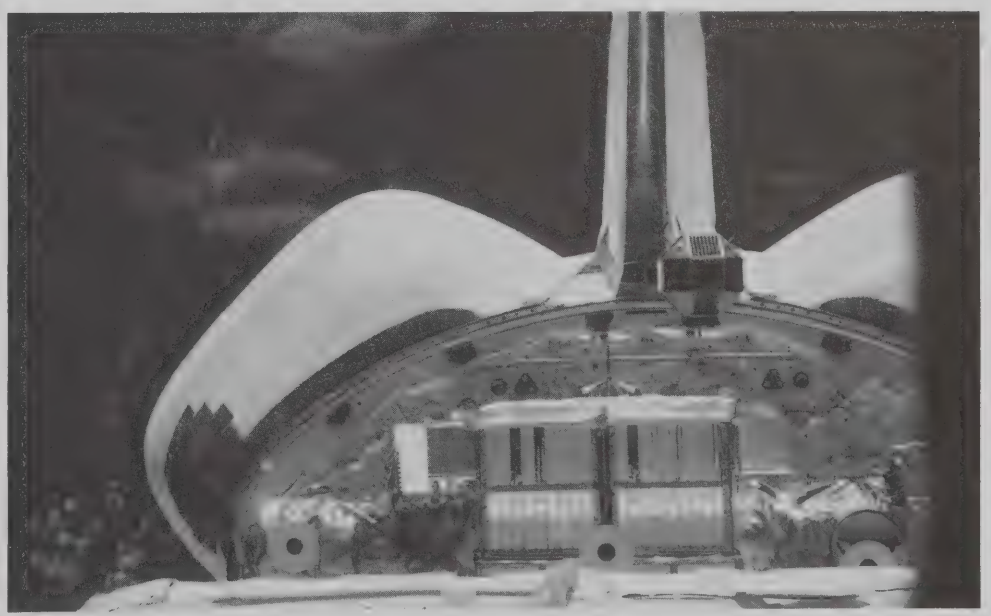
VOXSAT-1 Launch Plans

AMSAT-LU Vice President Gustavo Carpignano, LW2DTZ (*lw2dtz@amsat.org*) informs us that AMSAT-LU is in the last phases of constructing and testing VOXSAT-1, its next Radio Amateur satellite. Scheduled for a 1999 launch, VOXSAT-1 will be a part of a Russian satellite, similar to AO-21. VOXSAT-1's modes are:

- 2W Crossband FM Repeater (Mode U/V)
- Parrot (Mode V)
- 4W Voice, Fax, SSTV, Broadcast (Mode V)
- 4W Modulated CW TLM (Mode V)

AMSAT LU will provide a certificate to those who donate US $10 or more for funding of the final construction phase of VOXSAT-1. Those who donate US $100 or more will have their callsign included on the satellite. Donations may be sent to AMSAT-Argentina, c/o Gustavo Carpignano, LW2DTZ, PO Box 187, 1401 Buenos Aires, Argentina. Further information about VOXSAT-1 can be obtained via *http://members.xoom.com/Amsat_LU*.



Release of PANSAT from *Discovery's* cargo bay at 1734UTC, 30 October 1998. (NASA photo)

Phase 3D Thermal Vacuum Test at Orbital Sciences Corporation

Lou McFadin, W5DID

Preparations for the Phase 3D thermal vacuum tests began well before the start of the actual tests when Dick Jansson, WD4FAB, and I traveled to the Orbital facilities in Germantown, Maryland to look over the facilities and determine what was needed to prepare for the test. The personnel at Orbital were very helpful and welcomed AMSAT to their facility with much openness and generosity.

The main vacuum chamber at Orbital is 11 feet in diameter and is shaped like a cylinder lying on its side. This particular chamber was formerly used as a human-rated chamber so it has an airlock on one end and a large disc-shaped removable door on the other end. The chamber is equipped with a cold jacket wall at the sides and the ends, cooled with liquid nitrogen, that can lower the internal temperature to approximately –100° C. In order to cool the test subject to the low temperature required, the heat is allowed to radiate to the cold jacket. For Phase 3D the desired temperature was –20° C.

In order to achieve the high temperature requirement, 30 high-power quartz lamps are used to transfer heat by radiation to the test subject. During the first visit to Orbital, it was determined that the Phase 3D team needed to fabricate a frame to surround the spacecraft that would hold these quartz lamps at a fixed distance of 24 inches above and below the outer panels of Phase 3D. Constructing this frame was a major new task for the team that Bob Davis, KF4KSS and WD4FAB spearheaded (Figure 1).

As preparations progressed toward shipping Phase 3D to the test facility, modifications continued on a shipping container that had been previously been built by Brian Coggins, KC4LLD and designed by WD4FAB and Jeff Zerr. This container was designed to fit in a 747 aircraft cargo hold and was sized to allow for sway space so that Phase 3D wouldn't impact the container walls during shipment in worst-case conditions. The container was also designed to fit the specified internal dimensions of commercial rental trucks so you can imagine our shock when we found that the truck dimensions specify the wall-to-wall inner dimensions and do not take into account the three inches needed on each side for the roll-up door. This makes the clearance six inches smaller than the quoted dimensions. Therefore, the Phase 3D shipping container was three inches too wide to go in the door.

We were then faced with the need to either rent a special truck with wider dimensions or to build a new shipping container. The rent for the special truck was around $3,500 and would be needed several times before launch. It was decided to build a new simplified Phase 3D shipping pallet that would fit into a standard rental truck. This was another major task added at a time when the Phase 3D team was already very busy. The new pallet was to be suspended on a cushion of air using several auto inner tubes. This absorbed the shock of the many bumps on the road (Figure 2).

In addition to the air cushion, Phase 3D was also protected by an external steel frame that equally distributed the stresses between the top and bottom mounting bolts. We called this frame the *cocoon* and it was fitted so rigidly that we had to turn the satellite on its side to remove the load and therefore the flex from the mounting frame (Figure 3) in order to remove it.

Phase 3D's trip from Orlando Integration Laboratory, Florida to Germantown, Maryland was made in a Budget Rental truck. Rick Leon, KA1RHL and Bob Davis, KF4KSS drove the distance in two days. Upon arrival, Chuck Green, N0ADI was there to greet us and he stayed for the duration of the tests to provide valuable assistance. The truck was immediately moved into the building when it arrived at Orbital. It was like moving the Orlando Integration Lab as the truck was loaded with everything we could think we possibly needed for the tests. There were over 60 boxes in addition to the spacecraft! After unloading the boxes and Phase 3D from the truck, the spacecraft was moved into the clean room at Orbital (Figure 4).

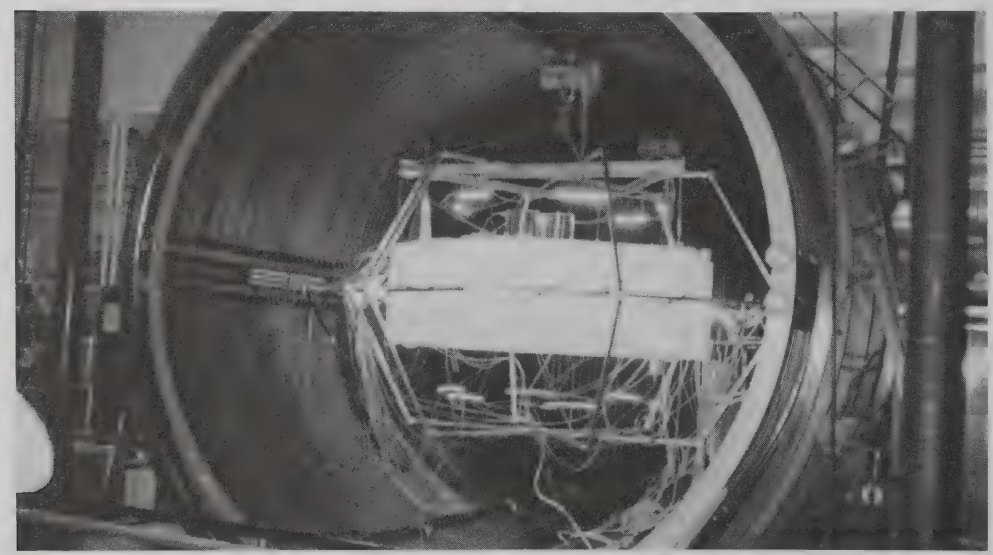


Figure 1. Phase 3D in the thermal chamber. Note the frame that was constructed which surrounds Phase 3D spacecraft. This frame that was designed to hold 30 quartz halogen lights for use in heating the spacecraft in a thermal vacuum environment. (photo by Bob Davis, KF4KSS)

Pre-Thermal Baseline Testing

At this point activities went into full swing preparing the spacecraft for the thermal vacuum tests. An antenna farm was placed on the roof of Orbital consisting of dual-band 2 meter/70cm, L band, and S band antennas. We used three Heliax cables approximately 150 feet long to connect between the roof antennas and the test area located near the spacecraft in the clean room. A duplexer was attached to the cable of the dual-band antenna so we only needed one cable for the 2 meter and 70cm antennas while the L band and S band antennas each had their own cables.

Phase 3D was powered up for the tests in the clean room at Orbital on Wednesday, 14 October and work immediately began on setting up the RUDAK ground station and the Phase 3D command station in the nearby Hampton Inn. Each command station was set up in its own room so that operations could proceed on a twenty-four hour basis. Appropriate transmitters and receivers were

set up and antennas were aimed through the motel windows towards Orbital. This setup allowed remote RUDAK operations to successfully begin when Harold Price, NK6K arrived on Thursday.

On Friday, GPS experts from NASA came to test the Phase 3D GPS system that has been supplied by NASA. This test was necessary in advance of the thermal vacuum tests as once Phase 3D was inside the vacuum chamber there would be no opportunity to receive GPS satellite signals. Their tests continued for two days and they were successful in obtaining attitude data using the Phase 3D perigee antennas. They were not successful in obtaining data from Phase 3D apogee antennas since the antenna preamps were not powered in this test configuration.

After completing the Phase 3D GPS tests, an international team arrived to participate in the thermal tests. Phase 3D Project Leader, Dr. Karl Meinzer, DJ4ZC supervised the thermal test activities and Werner Haas, DJ5KQ, Peter Guelzow, DB2OS from AMSAT-DL, and Michael Fletcher, OH2AUE from AMSAT-OH formed the RF test team (Figure 5).

Baseline testing began with testing of the 2 meter receiver, 70cm, X, and K band transmitters. In addition, the momentum wheels and RUDAK commanding via 2 meter uplink and 70cm downlink were verified. In the interest of time and the need to power down the spacecraft so that the quartz lamp framework could be installed along with thermocouples inside Phase 3D, we were not able to baseline all transmitters and receivers prior to putting Phase 3D in the vacuum chamber. After completing the installation of the heater frame and the coaxial cables to feed RF through the chamber walls, pump-down began around midnight on 22 October. By the next morning the chamber was at to the proper vacuum pressure to begin testing (Figure 6).

Tests Results

At the first vacuum test at room temperature the V band receiver, U band transmitter, X band solid state power amplifier, and TWT (travelling wave tube) were tested and were operating normally. Over a period of a week, Phase 3D was tested over five temperature ranges between –20°C to +45°C while in a vacuum. As with any spacecraft vacuum thermal test, we were able to determine and define the operating temperature limits of several of the Phase 3D systems. The vacuum

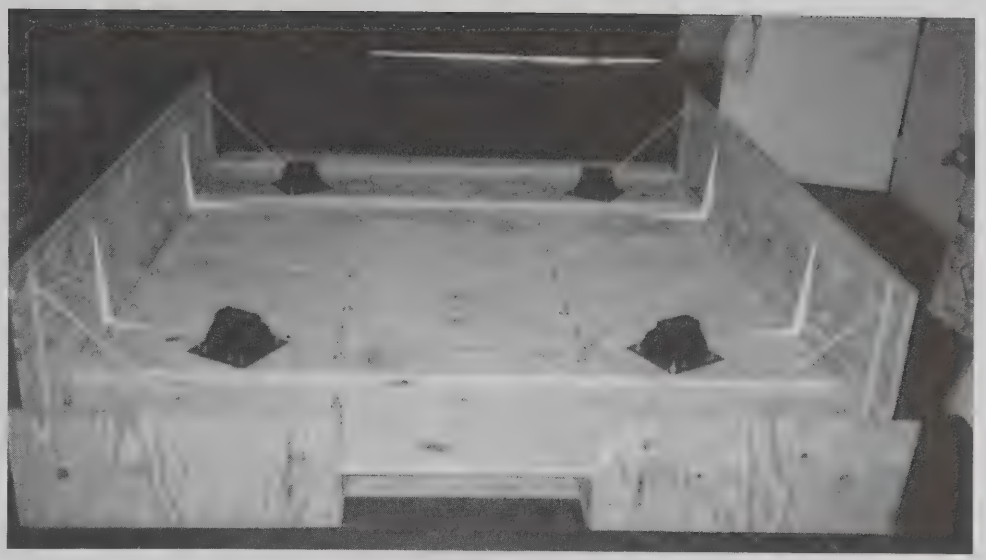


Figure 2. Phase 3D shipping palet. Note the rubber mats that are designed to reduce shock associated with ground travel. (photo by Bob Davis, KF4KSS)

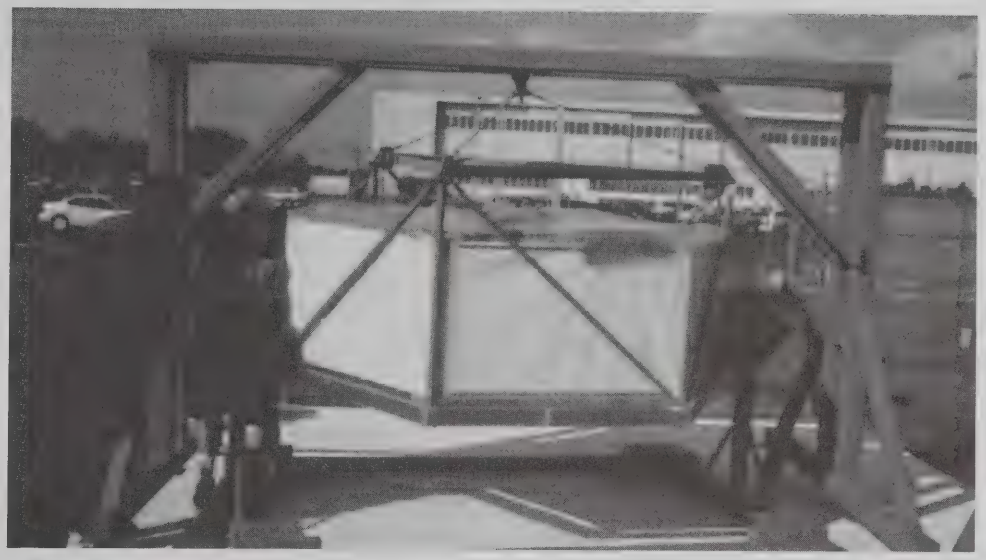


Figure 3. Phase 3D resting in its specially designed shipping *cocoon*. (photo by Bob Davis KF4KSS)

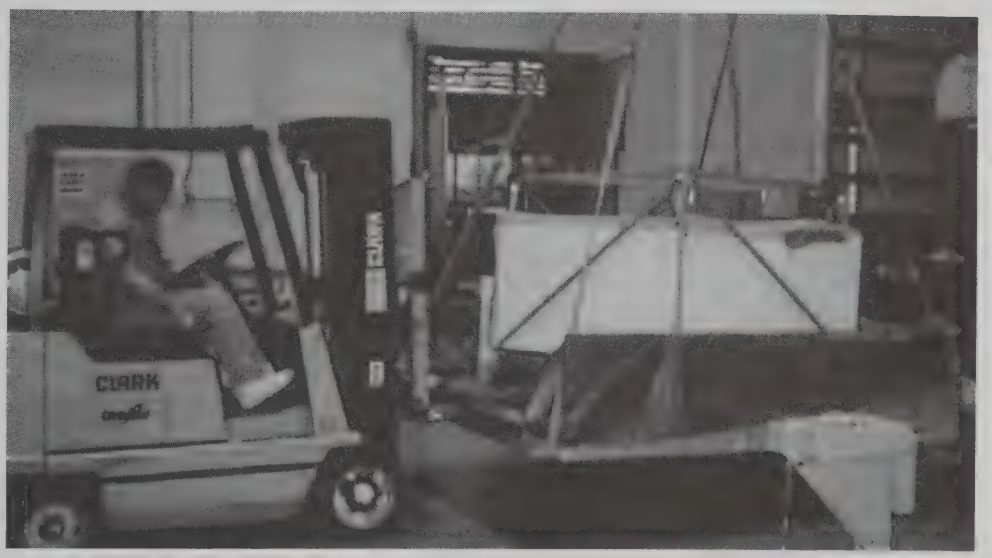


Figure 4. After arrival to the Orbital test facility from the Orlando Integration Lab, Phase 3D was removed and taken to an area were baseline measurements could be made prior to vacuum thermal testing. (photo by Bob Davis, KF4KSS)

Figure 5. Phase 3D Thermal Vacuum Test Team Members at Orbital Facilty. From left to right are Dick Daniels, W4PUJ; Chuck Green, N0ADI; Richard Leon, N1RAL; Bob Davis, KF4KSS; Lou McFadin, W5DID; Peter Gülzow, DB2OS; Michael Fletcher, OH2AUE; Dan Schultz, N8FGV; and Werner Haas, DJ5KQ. (photo by Orbital Sciences Corporation)

thermal test did reveal that there were no anomalies with the Phase 3D spacecraft that will cause any major problems during flight. Some significant results of the test are:

- Receivers: The U band, S band, and C band receivers performed nominally.
- Momentum Wheels: The momentum wheels performed as planned with no problems.
- RUDAK: Bdale Garbee, N3EUA, Jim White, WD0E, Harold Price, and Chuck Green tested the RUDAK and found no major problems. During the test they were able to successfully take some photographs using the JAMSAT scope camera.
- Battery Charge Regulators: We found some problems with the battery charge regulators (BCR) that were not related to the thermal vacuum tests. The BCRs tend to interact with each other since they are each independently trying to control the bus voltage. This is the first time we have used three BCRs together in this configuration, so some integration issues were expected. This issue will be addressed back at the Orlando Integration Lab.

Figure 6. Start of the one-week thermal vacuum test of Phase 3D. The test allowed various Phase 3D components to be tested in a simulated space environment. (photo by Bob Davis, KF4KSS)

The Phase 3D spacecraft is an order of magnitude more complex that any other amateur radio satellite and therefore, technical difficulties are equally more complicated to resolve. However, the Phase 3D thermal vacuum tests successfully achieved the intended results. As a result of these tests, we now know the operating limits of the equipment onboard Phase 3D in a space environment. We also have a handle on how to deal with the problems that did occur during the tests.

Taking the Next Final Steps

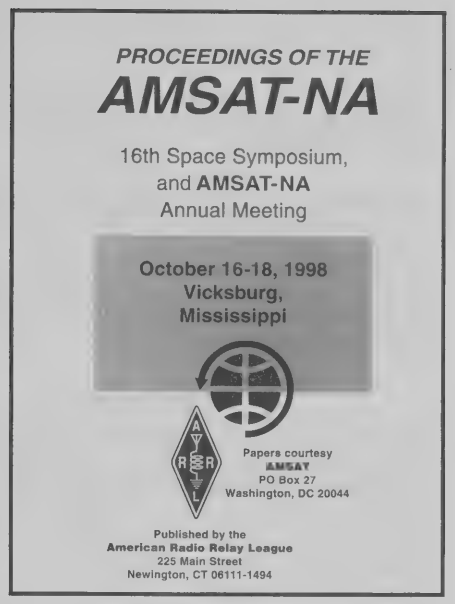
Phase 3D has now been returned to its temporary home in Orlando and work is beginning on the next phase of its journey into space. There will be another Phase 3D integration test in January 1999 to prepare the spacecraft for vibration testing. Modifications will be made based on the results of the vibration tests. Afterwards only minor modifications will be made to Phase 3D prior to launch.

I would like to take this opportunity to thank all the volunteers who came out to Orbital to help monitor these tests and to help with other tasks. These include:

- Frank Bauer, KA3HDO who loaned us his dual band antenna and other equipment.
- Pat Kilroy, WD8LAQ who helped organize the volunteers and the tours of other members who just wanted to see Phase 3D.
- Perry Klien, W3PK who took several night watches at the chamber site and loaned us the free use of his cellular phones.
- Ron Parise, WA4SIR who took time out of his busy schedule to round up much needed test equipment.

A special thanks goes to the management at Orbital who made an extremely valuable contribution to the Phase 3D effort. Orbital knows how to do spacecraft! While the staff at Orbital that helped us are too numerous to list in their entirety, special thanks go to Rex Richardson who is in charge of the test facilities; John Cavallo, KB3BWP who volunteered to oversee the test and provided valuable support; and Harry Shipley who seemed to know everyone at Orbital and who can find anything and do it in short order! ■

Dick Daniels, W4PUJ (standing) and Rick Leon, KA1RHL performing adjustments to Phase 3D during clean room power on operations. Note the wire antenna taped to the right window. (photo by Harry Yoneda, JA1ANG)



AVAILABLE FROM AMSAT

Satellite Orbital Elements

by Ray Hoad, WA5QGD

Satellite	AO-10	AO-27	FO-20	FO-29	RS-12/13	RS-15	RS-16	PANSAT
Catalog Number	14129	22825	20480	24278	21089	23439	24744	25520
Epoch Time	98318.86783000	98316.18679927	98316.20206222	98315.96655209	98316.86390988	98316.34236582	98316.81073497	98307.57212001
Element Set	557	701	108	205	110	342	313	16
Inclination	26.7600	98.4884	99.0505	98.5285	82.9197	64.8188	97.2365	28.4155
RA of Node	58.482	22.4078	187.0126	291.4829	257.6674	43.0626	218.5401	127.1221
Eccentricity	0.59972	0.0008358	0.0540245	0.0350986	0.0028356	0.0150792	0.0008693	0.0015845
Arg of Perigee	265.8370	172.7407	296.2818	296.9775	309.9791	32.8608	62.6056	29.5288
Mean Anomaly	216.5650	187.3894	58.3741	59.591	49.8859	328.158	297.6066	331.4083
Mean Motion	2.05838221	14.27819079	12.83247490	13.52652703	13.74111472	11.27531540	15.41628230	15.03001976
Decay Rate	0.00000000	0.0000022	-0.00000035	0.00000026	0.00000048	-0.00000039	0.0002413	0.00028862
Epoch Rev	0	26727	41050	11044	38970	15979	9486	71
Satellite	RS-18	UO-11	UO-14	AO-16	DO-17	WO-18	LO-19	MIR
Catalog Number	25533	14781	20437	20439	20440	20441	20442	16609
Epoch Time	98320.01181243	98315.96211424	98316.18767279	98316.18644766	98316.19034358	98316.20104309	98316.19554074	98316.76964559
Element Set	2	104	400	209	190	201	197	947
Inclination	51.6649	97.8993	98.4759	98.5028	98.5092	98.5078	98.5132	51.6606
RA of Node	354.9517	283.7285	30.5804	34.8496	36.1362	35.97	36.9694	11.5427
Eccentricity	0.0008572	0.0012057	0.0011361	0.0011418	0.0011401	0.0012022	0.0012341	0.0007798
Arg of Perigee	347.6107	159.2015	132.1731	134.9183	133.2858	134.6205	133.5824	323.2706
Mean Anomaly	12.4565	200.9686	228.0417	225.2931	226.9296	225.5938	226.6381	36.7867
Mean Motion	15.7232045	14.70001574	14.30072368	14.3011292	14.30262841	14.30221593	14.30344819	15.70688394
Decay Rate	0.00135067	0.00002098	0.00000475	0.00000447	0.00000567	0.00000591	0.00000585	0.00029303
Epoch Rev	73	78657	45953	45955	45959	45959	45962	72736
Satellite	UO-22	KO-23	KO-25	IO-26	TO-31	GO-32	SEDSAT-1	Phase 3D (est)
Catalog Number	21575	22077	22828	22826	25395	25397	25509	99934
Epoch Time	98316.16394991	98316.04818992	98316.23444784	98316.18516970	98316.18983136	98316.19687038	98316.20660872	96260.25523447
Element Set	908	793	679	681	63	146	53	3
Inclination	98.2281	66.0796	98.4864	98.4904	98.7894	98.7844	31.4463	60.0203
RA of Node	1.5132	151.4035	22.9667	22.8047	25.8803	25.8395	290.2428	342.7876
Eccentricity	0.000737	0.0015447	0.0010041	0.0008941	0.0001127	0.0001633	0.036906	0.6752895
Arg of Perigee	147.2886	274.9551	154.9753	172.7525	124.7478	29.8381	52.0437	180.1221
Mean Anomaly	212.8757	84.9704	205.1914	187.3778	235.3942	330.289	311.2945	179.5089
Mean Motion	14.3720782	12.86313823	14.28292668	14.27935126	14.2228532	14.22198949	14.23754703	1.51063968
Decay Rate	0.00000601	-0.00000037	0.00000436	0.00000287	-0.00000045	-0.00000045	0.00001025	0.00002
Epoch Rev	38416	29371	23544	26729	1777	1779	266	2

The Amateur Satellite Service in 1998: Presented to the XIII General Assembly of IARU Region II, MARGARITA 98, 28 September 1998

Ray Soifer, W2RS and Hans van de Groenendaal, ZS5AKV

If there is one message that we would like to leave with you it is that the Amateur-Satellite Service is alive, well, and needs your help.

Let us begin with a brief survey of current amateur satellite activities, operational and technical, and then move on to look at the programs now in the construction and development phases which will take us well into the 21st Century. Finally, we will touch upon areas in which we hope that IARU Region 2 and its Member Societies may be able to assist.

A Statistical Profile

According to a survey conducted two years ago by W2RS (see *The AMSAT Journal*, Sept/Oct 1996) through participating AMSAT organizations (more about AMSAT later), there were then approximately 18,000 radio amateurs participating, in one way or another, in the Amateur-Satellite Service, nearly half of them residing in Region 2. Of those, about 8,000 considered themselves currently active, i.e., operating via satellites at least once a month (4,000 in Region 2), with another 6,000 considering their stations *satellite-capable* but not as active as that (3,000 in Region 2).

Approximately 25% of those with *satellite-capable* stations (whether *currently active* or not) were equipped to use digital satellites, while the rest made use of so-called analog transponders via CW, SSB or FM.

These numbers may not sound very impressive at first blush, but they are quite comparable to the statistics for HF DX and contesting, two facets of Amateur Radio requiring similar levels of commitment on the part of the operator. In the most recent year, for example, 4,324 amateurs participated in the DXCC program, and the total number of individuals (Honor Roll members plus annual participants) listed in the most recent DXCC Annual List was 6,710. Approximately 3,000 stations, with perhaps 5,000 participating operators, enter the ARRL DX Contest each year.

Like most active amateurs, participants in the Amateur-Satellite Service tend overwhelmingly to be members of their national IARU Societies. According to our survey, about 80% of them — about 16,000 — also belonged to a national AMSAT organization.

Along with most other statistical indicators of the state of Amateur Radio, AMSAT membership has declined since 1996; from a peak of slightly more than 8,000, membership in AMSAT North America — whose territory covers the USA and Canada, but which also has members in many other countries throughout the world — is now approximately 6,000. We shall return to this subject later on.

AMSAT and IARU

AMSAT organizations do not have a structured international federation comparable to IARU, nor do they want one — one IARU is enough, and AMSAT wants to continue to work with it effectively. Rather, nearly all AMSAT organizations communicate with one another through AMSAT-International, an Internet distribution list maintained by AMSAT-NA and moderated as part of his official duties by W2RS. Since 1995, they have also gathered once a year in person at the IARU International Satellite Forum. Convened by ZS5AKV in his role as IARU Satellite Adviser; these meetings are currently held in Regions 1 and 2 in alternate years, in conjunction with the AMSAT-UK Colloquium and the AMSAT-NA Space Symposium, respectively. This Forum has superseded an earlier annual gathering – the International Satellite Meeting — hosted from 1989 through 1994 by AMSAT-UK in which IARU officials were invited to participate, and generally did — mainly those from Region 1, although VE3CDM and ZL3QL had been among the more notable exceptions.

One of the Forum's functions is to participate in the annual appointment of the IARU AMSAT Frequency Coordinator, who according to Terms of Reference agreed in 1994 by the IARU Administrative Council, is responsible for frequency coordination in the amateur-satellite band segments on a worldwide basis. The coordinator is nominated by the IARU Satellite Adviser with the approval of the AMSAT organizations represented at the Forum (or, in the event of a mid-term vacancy, through AMSAT-International). We are pleased to report that the incumbent, Graham Ratcliff, VK5AGR, was reappointed unanimously at the 1998 Forum, held at the University of Surrey in England, and received the Forum's thanks for his outstanding work during the past three years.

Amateur Radio Satellites

So much for statistics and organizational matters. What about the satellites themselves? Approximately 50 Amateur Radio satellites have been orbited since 1961 (not counting manned space missions, about which more later). Of these, 17 were operational as of the date this paper was written in September 1998.

Four of these are full-time analog spacecraft:

- AMSAT-OSCAR 10, an international satellite launched in 1983 and still operating in part-time service despite severe damage over time, at three times its design lifetime of five years. However, it is no longer capable of responding to commands, and its future is questionable at best. A high-altitude, elliptical-orbit satellite capable of providing intercontinental DX QSOs on CW and SSB of up to 12,000 miles (20,000 km), AO-10 has now outlived its planned successor, AMSAT-OSCAR 13, which burned up in the atmosphere in 1996 after 8 1/2 years of service. AO-10 has a 70 cm uplink and 2 m downlink.
- RS-12 and RS-15, launched in 1991 and 1994, respectively, by our Russian colleagues, are *little LEOs* — small satellites in low earth orbit, actually *parasite* experiments on non-amateur Russian spacecraft. Both are intended for CW and SSB communication. RS-15 has a 2 m uplink and 10 m downlink. While RS-12 is also capable of operating in this mode, it is currently programmed to uplink in the 15 m band and to downlink on 10 m. As LEOs, however, their communication range and length of possible QSOs are far shorter than those of AO-10.
- AMRAD-OSCAR 27, which recently celebrated its fifth birthday, was originally intended as a commercial satellite, but was completed by AMRAD, a technically-oriented radio club based in Northern Virginia, with assistance from AMSAT-NA and AMSAT-Italia. Managed by AMRAD, it is an FM repeater with input at 2 m and output at 70 cm, and is in a LEO orbit with an altitude of 800 km.
- Two satellites, Fuji-OSCAR 20 and Fuji-OSCAR 29, built and placed into LEO orbit in 1990 and 1996, respectively, with the funding and sponsorship of JARL, are capable of either analog (CW/SSB) or digital communication (switchable by ground command). Their uplinks are at 2 m and downlinks at 70 cm.

In addition to FO-20 and FO-29, there are ten more presently-operational digital OSCARs. These satellites, placed into LEO orbits between 1990 and 1998, are intended for store-and-forward packet radio communication, remote imaging or both, generally with 2 m uplinks and 70 cm downlinks.

Among the AMSAT organizations responsible for building and launching these ten digital spacecraft are those of Argentina, Brazil, Israel, Italy, South Korea, Thailand and the United Kingdom, in addition to the USA. AMSAT-Mexico has also built two such satellites although neither is currently operational.

The remaining amateur satellite in active service is UoSAT-OSCAR 11, a scientific research satellite built in Great Britain in 1984, which is also used today by AMSAT-UK to send Amateur Radio bulletins in ASCII format. In its time, UO-11 played important roles in several polar expeditions. It was the second Amateur Radio satellite designed and built at the University of Surrey by Professor Martin Sweeting, G3YJO and his team, which has since gone on to build six more in addition to several birds for non-amateur use. Queen Elizabeth II has visited G3YJO's laboratory and has also made him an Officer of the Order of the British Empire (OBE) for his efforts; Ron Broadbent, G3AAJ, longtime Honorary Secretary of AMSAT-UK, was made a Member of the Order of the British Empire (MBE) for his services to Amateur Radio.

Earth Station Requirements

We should point out that, in addition to those amateurs who are capable of accessing modern digital satellites directly, virtually every one of your members who operates packet radio with a simple TNC and terminal has probably made use of the digital amateur satellite network, by sending and receiving packet messages that have passed through satellite gateway stations. There are several dozen of these in operation worldwide, speeding messages on their way by satellite at transmission times typically far shorter than those obtained through HF relay, and offering a viable, all-amateur alternative to the use of the Internet for long-distance packet message traffic.

User requirements for amateur satellites vary widely, from the digital spacecraft TMSAT-OSCAR 31 which operates at 38k and requires the user to have a receiver with a phase-linear bandwidth of 65 kHz, attainable with home-constructed equipment but not yet with any commercially-built receiver on the amateur market, to RS-12 which may be operated with any multiband HF transceiver with an RIT control and a fast bandswitch (or preferably, crossband memory operation), and AMRAD-OSCAR 27 through which one may make FM QSOs with nothing more than a dual-band handheld that covers the appropriate frequencies (such as the Yaesu FT-50R) and a dual-band whip antenna such as the MFJ-1717.

This morning, W2RS worked four stations on AO-27 — N1XAU in New Hampshire, N1JEZ in Vermont, and K8TL and KB8TJX in Ohio – with this equipment from the parking lot of the hotel. He will demonstrate AO-27 again tomorrow at 1100 local time; would those interested in seeing this demonstration meet him then in front of the hotel. (A total of 15 stations were worked on AO-27 during demonstrations at the conference.)

Technical Achievements

In a short presentation such as this, it is not possible to explore fully the technical sophistication and contributions to scientific and engineering knowledge which the current Amateur-Satellite Service represents. Some of this undoubtedly reflects the professional engineers and scientists, many of them tops in their fields, who work in AMSAT as a sort of busman's holiday, but many students and non-professional radio amateurs have contributed enormously.

One way to give some flavor, at least, of the technical work that is going on is to list the titles of some of the papers presented at the most recent AMSAT-NA and AMSAT-UK annual meetings (the full texts and authors may be found in the published Proceedings).

- Design and Application of Internet-Linked Ground Station for the Amateur Satellite Community
- Using Broadcast Protocols On Terrestrial Links: A New Approach To Digital Satellite Gateways
- An Object Oriented Approach to Automatic Radio Tuning
- Developing Portable Satellite Software Using Java
- Design Of A Space Image Processing System
- Digital Voice Modulation for a Future Generation of Ham Satellites
- Performance Testing of a RESISTOJET Thruster for Small Satellite Applications
- An Investigation of the Application of Turbo Codes for LEO Microsatellite Communication
- A New Method for Small Satellite Nadir Tracking Application
- Topside Ionospheric Sounding MicrosatelliteSoftware Demodulation Using the DSP'C31 Digital Signal Processing Payload
- Class F High Efficiency Power Amplifier Design for Microsatellite Radar Altimeter Payload
- Preliminary Results of Attitude Determination Using GPS Signal Strength Measurements

And that's only a small sample of what was discussed at just two meetings of the AMSAT community! So much for those who argue that Amateur Radio no longer makes meaningful contributions to technology.

At the 1997 AMSAT-NA Space Symposium in Toronto, ZS5AKV suggested in his keynote address that papers such as these should be presented in professional meetings and journals, and not only in the Amateur Radio community. We are working towards that end.

The Manned Space Program: SAREX, *Mir* and ARISS

Of great importance to Amateur Radio generally, especially in our efforts to benefit education and to attract more young people to our service, is the manned space program.

YV7/W2RS by YV7/W2RS

At last year's Space Symposium in Toronto, IARU Region 2 President Tom Atkins, VE3CDM, invited AMSAT-NA to send an observer to the 1998 Region 2 Conference, to be held in Porlamar, Margarita Island, Venezuela, from September 28th through October 2. The AMSAT Board of Directors accepted Tom's kind invitation, and asked me to go.

Each of IARU's three regions meets once every three years. The regional conference includes top-level representatives of each national member society in the region, plus observers from the other two regions and the officers of IARU itself. In short, it's a great audience before which to tell AMSAT's story.

Tom arranged for one of the conference's plenary sessions to hear a presentation by myself and IARU Satellite Adviser Hans van de Groenendaal, ZS5AKV, published elsewhere in this issue. One of the things we wanted to illustrate was how easy some of our satellites are to use, since many of the countries represented at the conference have little or no satellite operation. Although it wasn't practical to try to do it during the talk itself, I decided that one way of illustrating this was to take my Yaesu FT-50R handheld and MFJ-1717 dual-band whip antenna to Porlamar, and make some contacts on AMRAD-OSCAR 27 using this simple, bare-bones station with as many delegates as possible looking on.

Margarita Island is located in the Caribbean, about a 45-minute flight northeast from Caracas. The grid square for Porlamar is FK80. To the best of our knowledge, Margarita has never been on any amateur satellite before.

Our gracious hosts from Radio Club Venezolano arranged for conference attendees to be granted guest operating privileges during our stay, with the prefix YV7 (signifying the State of Nueva Esparta, of which Margarita Island is a part) before our home calls. In addition, they set up a fine club station, YV7AJ, featuring a modern HF transceiver and linear amplifier along with a triband beam and vertical antennas. That also raised the possibility of RS-12/13, Mode K, with 15 meters up and 10 meters down.

Long experience, which I've ignored at my peril more than once, teaches never to do a public demonstration of anything that you haven't tried in private first. So, on Monday, September 28th, I ran tests of both RS-12/13 and AO-27, with very different results.

The RF noise level at the conference hotel turned out to be so high on 10 meters that I was unable to hear any downlink signals at all from RS-12/13, although I wound up giving out about 300 QSOs on 20 meters from YV7AJ to a large pile-up of IOTA hunters. (The IOTA number of Margarita Island is SA-012.)

Fortunately, AO-27 turned out to be a much happier experience. On Monday morning, the 28th, I took my handheld and whip out to the hotel parking lot, where we would be looking north. The first pass of AO-27, at 1350 UTC, was to the east of Porlamar and its footprint only grazed the easternmost portions of North America at very low elevation angles. Nonetheless, that pass resulted in the first known amateur satellite contact from Margarita Island, with Bridget Wyrick, N1XAU, in New Hampshire. The second test pass, at 1530 UTC, was to the west of Porlamar at a maximum elevation of 15 degrees, and three stations were worked: N1JEZ, K8TL and KB8TJX.

Although my commitments to the conference, where I also served as secretary of the committee on VHF/UHF and satellites (chaired by Cesar Daglio, LU8EBF, of Radio Club Argentino and AMSAT-LU), precluded my being able to operate on every AO-27 pass, I did get three public demonstration passes in, on Tuesday, Wednesday and Friday mornings. Each demo played to a successively larger audience, to which I must give a lot of credit for coming because the outdoor temperature was about 100 degrees Farenheit in the shade, and the parking lot was in the bright tropical sun. On my final demonstration pass Friday, I was delighted to have IARU President Dick Baldwin, W1RU, volunteer to act as logger, and fortunate indeed to work six stations during the pass. The logger during Wednesday's pass, when four stations were worked, was Paul Rinaldo, W4RI, of ARRL; Cesar, LU8EBF, was the logger on Tuesday's demo, when we worked three.

All told, we had 17 AO-27 QSOs with 15 different stations during the five passes on which YV7/W2RS was active. (I tried a sixth pass before departing on Saturday morning, but it was so far to the east that I was the only station on the bird.) Three Canadian stations were worked (VA3EJN, VE3FRH and VE3NPC) and 12 U.S. stations as far west as Iowa (N8OCX/0). If you worked YV7/W2RS, please QSL to my home call. If you worked YV7AJ on HF and would like a card, please QSL via the Venezuelan QSL bureau.

One interesting sidelight: due to power limitations, AO-27 is currently programmed to turn itself on 18 minutes after crossing the terminator into sunlight, than to turn itself off 18 minutes later. Because Porlamar is so far south, we found that the bird always turned itself off just after reaching its maximum elevation at our QTH, giving us only about half the normal pass time and no window at all to the southern parts of South America. Much of the Southern Hemisphere has no access to AO-27 at all.

As Abraham Lincoln once said, "you can't please everybody all the time." Were the satellite to turn on later in its orbit so as to remain on for longer periods at tropical latitudes, our friends in Canada and northern Europe would have less access. That said, I wish a way could be found so that all parts of the world could have access to AO-27 at least some of the time. I have the same wish about the orbital planning for Phase 3D, although it's premature to think about that until a launch opportunity is identified.

In closing, I would like to thank our hosts, the members of Radio Club Venezolano, for their hard work and outstanding hospitality before, during and after the conference. Because of their efforts, not only did I have a wonderful time but the IARU Region 2 Conference was productive and enjoyable for everyone. I also want to thank the ladies and gentlemen who were operating on AO-27 during our passes for calling in so orderly a fashion and standing by while others were being worked. May all DXpeditions have the good fortune to work hams like you, and vice versa. ■

Initiated by Roy Neal, K6DUE, former space and science correspondent for NBC News, Amateur Radio operation in space began with Owen Garriott, W5LFL, aboard the Space Shuttle Columbia in 1983 and has grown ever since. Today, more than half of the NASA astronaut corps consists of licensed amateurs, and there are not one but two Amateur Radio stations aboard the Russian *Mir* space station.

School and youth group contacts with these stations are extremely popular and often attract great attention in the public media. They are arranged in accordance with a carefully-constructed educational program, which is administered by Rosalie White, WA1STO, at ARRL Headquarters.

In July 1998, the second full-scale organizational meeting was held of ARISS, the international team which is hard at work on Amateur Radio on the International Space Station. We were there, and there are many exciting projects in progress. Permission has been granted for the station to be placed on board, which will be done in several phases between 1999 and 2004. In addition to the communication facilities, which will be far superior to those aboard *Mir* and the Space Shuttle, Amateur Radio has been invited to place scientific payloads on the Station's *Express Pallets*.

Proposals for these will be solicited in due course.

Incidentally, K6DUE chaired the 1998 meeting as well, which was held at the University of Surrey in England. Dr. Frank Bauer, KA3HDO, of AMSAT-NA and NASA, is chairman of the ARISS Administrative Committee, and Lou McFadin, W5DID, a retired NASA engineer and also of AMSAT-NA, chairs the ARISS Technical Committee. AMSAT organizations and IARU Member Societies of eight ISS participating countries have signed the ARISS MOU, and those of several other countries are participating as well.

Phase 3D

That brings us to Amateur Radio's other great space initiative for the early 21st Century, the Phase 3D satellite. Time does not permit a full description of this amazing spacecraft's capabilities, which has appeared in print elsewhere, but suffice it to say that Phase 3D will be bigger and better than any high-altitude, elliptical orbit Amateur Radio satellite ever. It is expected to make the 1.2 and 2.4 GHz bands even easier to use for worldwide satellite communications than were 144 and 435 MHz with its predecessor birds, although 144 and 435 MHz facilities will of course be included as well.

Now nearly completed in AMSAT-NA's Orlando, Florida laboratory facility, Phase 3D regrettably missed its scheduled launch opportunity aboard Ariane 502 earlier this year, due to a last-minute change of specifications by the European Space Agency. Project Leader Dr. Karl Meinzer, DJ4ZC, is working hard to negotiate a new launch, which he currently expects to occur within the next 12 months.

DARC, ARRL, RSGB, JARL and many other IARU Member Societies have already made substantial financial contributions to Phase 3D, which is still in need of funds due primarily to the launch delay and to the cost of the structural improvements needed to meet ESA's new specifications. Any further assistance which your Member Societies may be able to provide by way of fund-raising would be most gratefully received.

Based upon previous experience, some of the recent decline in AMSAT membership is thought to have stemmed from the delay in Phase 3D's launch, especially since the demise of AMSAT-OSCAR 13 in December 1996. To that extent, we consider it to be temporary. Another portion, however, is undoubtedly related to the general decline in Amateur Radio participation, which is being discussed elsewhere in this Conference.

SUNSAT

Time also does not permit a full discussion of the many smaller satellite projects which are now in various stages of completion. We should, however, mention SUNSAT, the Stellenbosch UNiversity SATellite, which will be South Africa's first. It will contain a 145.825 MHz *parrot* voice repeater as well as both 1200 and 9600 baud packet radio capabilities. There will also be a number of scientific and educational payloads. SUNSAT is presently scheduled for launch on 17 December 1998.

Collaboration with Universities

SUNSAT and the University of Surrey satellites bring to mind a very important point. With the principal exceptions of Phase 3D and ARISS, nearly all of the Amateur Radio spacecraft presently under development are being built at universities, and even Phase 3D and ARISS have substantial university participation. The romantic days of OSCAR satellites being built in basement workshops are, for all practical purposes, over.

The principal reason for this, as G3YJO of the University of Surrey has pointed out, is that *there's no longer any such thing as a free launch.* Satellite launching agencies, more in need of funding than ever before, have discovered that they can charge serious money, typically millions of dollars, for the *piggyback* launches that were once given away free. It is the universities that are able to attract the funds to pay for these launches, primarily from government and industry sources that are interested in training scientists and engineers and in sponsoring research projects of technical interest.

AMSAT organizations, many of which have had strong university roots to begin with, must work to improve their relationships with the university community if we are to continue to put satellites into orbit. AMSAT-NA, for example, has recently begun working with the University of Toronto on the MOST program, a scientific satellite that may also carry an Amateur Radio experiment.

Support for FASC Initiatives

For many reasons, including this, AMSAT supports the proposal of IARU FASC for a new Section S25 of the ITU Radio Regulations. A modernized set of regulations, such as these, would help us to serve the needs of today's more complex world, while preserving the essence of what makes Amateur Radio unique. Incidentally, AMSAT takes no position as to the differences between the FASC proposals in its Second and Third Reports, as these differences relate solely to the matter of qualifications for an amateur license which we are content to leave to our members' discretion.

AMSAT also supports the FASC proposals to remove the phrase *on earth satellites* from the official definition of the Amateur-Satellite Service, so that it would apply to all stations in outer space and not only to those in earth orbit, and to retain the separate provisions for the Amateur and Amateur-Satellite Services. Both proposals were endorsed unanimously by the IARU International Satellite Forum in 1996.

Spectrum Management Matters

In addition to those mentioned already, the Amateur-Satellite Service needs your help with several matters having to do with spectrum management.

As mentioned in ZS5AKV's report to the IARU AC as Satellite Adviser, the 1998 IARU International Satellite Forum expressed serious concern over the plans of some countries to license non-amateur stations, not provided for in the ITU Table of Frequency Allocations, in Amateur-Satellite Service bands, where they would be capable of causing harmful interference to amateur communications throughout the world. For example, one such proposal by the government of Guatemala would place commercial land mobile stations directly within the uplink passband of AMSAT-OSCAR10 where they can be heard as much as 20,000 km away. The Forum supported the efforts of IARU Region 2, and of CRAG, to deal with this situation, and urged Regions 1 and 3 to get involved as well.

With respect to manned space operations, experience has shown that such activities in the 2 m band attract far greater participation, especially among newer amateurs and those in developing countries, than those in the 70 cm and higher frequency bands, and adequate spectrum must continue to be found for them. ARISS will, in due course, require additional frequencies in this band.

Another spectrum management issue of continuing importance is the need to protect critical satellite sub-bands, e.g., 29.3-29.5, 145.8-146.0 and 435-438 MHz, from interference by terrestrial amateur stations. As mentioned earlier, our IARU AMSAT Frequency Coordinator, VK5AGR, is doing an excellent job of coordinating satellite use of these sub-bands on a worldwide basis, but this is easily capable of being frustrated by local interests, whose signals might then cause worldwide interference through satellite relay without their even knowing about it.

Finally with respect to spectrum management is the request, adopted by the 1997 IARU International Satellite Forum held in Toronto, for IARU to place on its agenda the possible allocation of new Amateur-Satellite Service bands in the 50 MHz region and also at 29.7-30.0 MHz by a future WRC. It is recognized that this will take time, but would be helpful both from the communications standpoint and also from that of propagation research.

(*The Conference passed resolutions supporting the Guatemalan member society's position on frequency allocations, urging inter-regional cooperation on manned space frequencies through ZS5AKV's efforts, and proposing the eventual allocation of Amateur-Satellite Service frequencies near 50 MHz. IARU is already on record as proposing such an allocation at 29.7-30.0 MHz. — W2RS*)

In Closing: Thank You

In closing, we wish to thank Region II President Tom Atkins, VE3CDM, for inviting us to make this presentation, as well as for his strong leadership over the years. This was especially evident in the 1994 IARU Ad Hoc Satellite Committee, which Tom chaired and on which ZS5AKV also served. It was the work of this committee which laid the foundation of the excellent and productive working relationship that now exists between IARU and AMSAT. May this long continue.■

Errata

Reference last month's 10.4 GHz Downlink article. SSB Electronics is the only U.S. source for Kühne downconverters.

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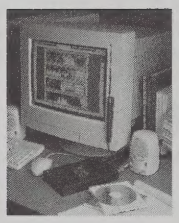

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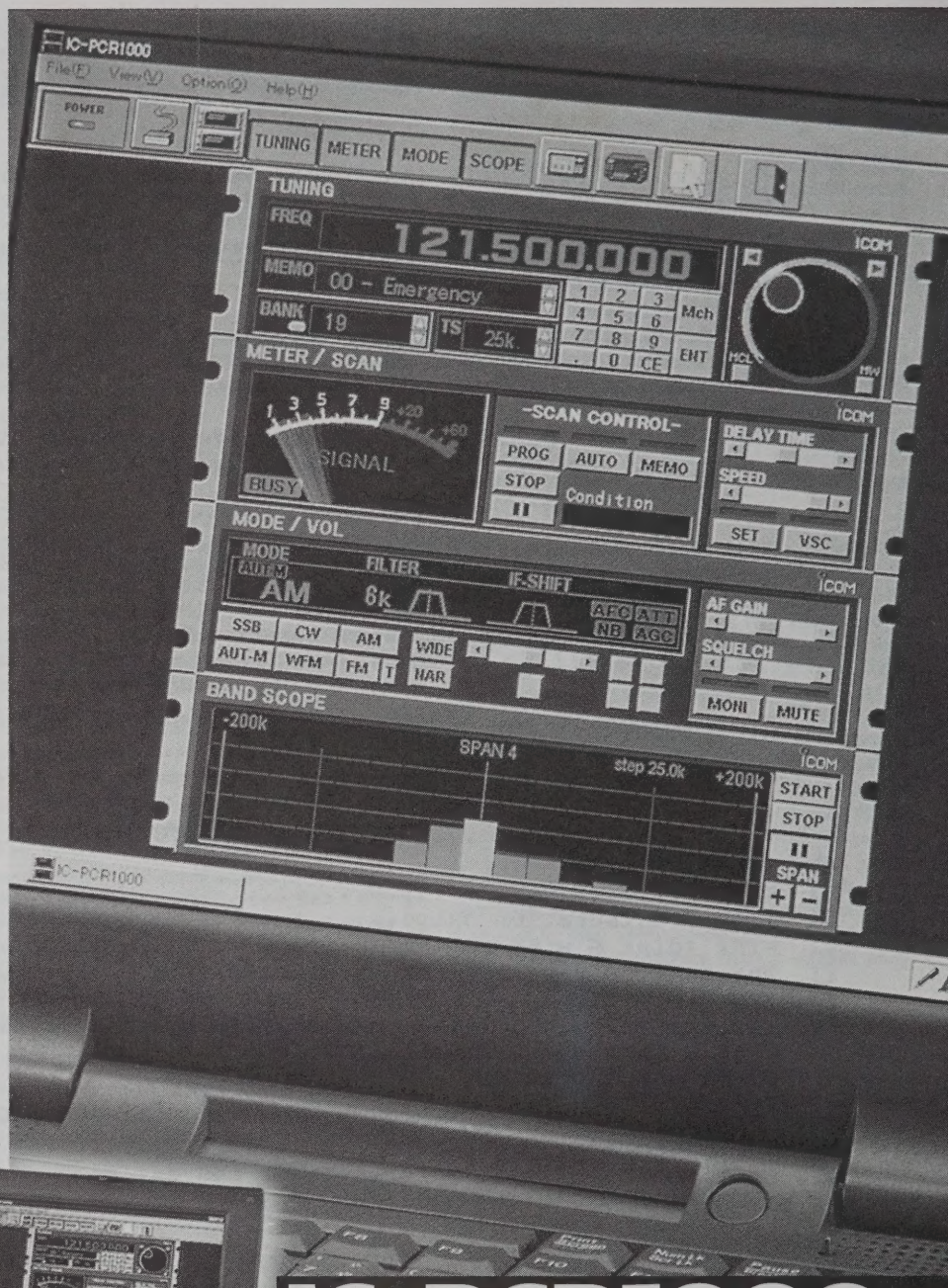

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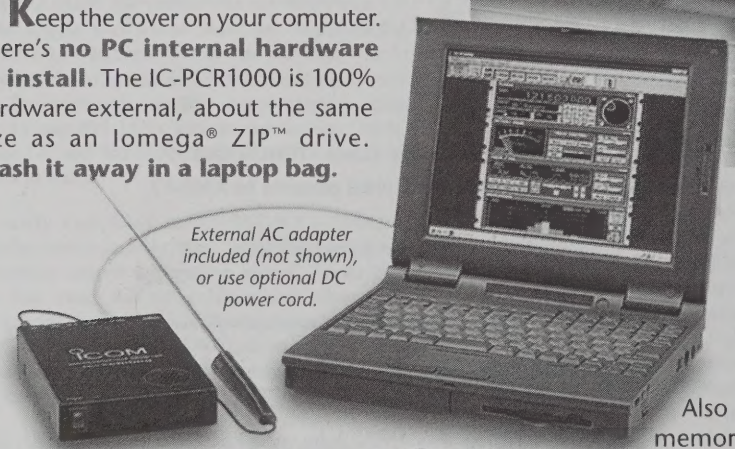

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